The science news monthly

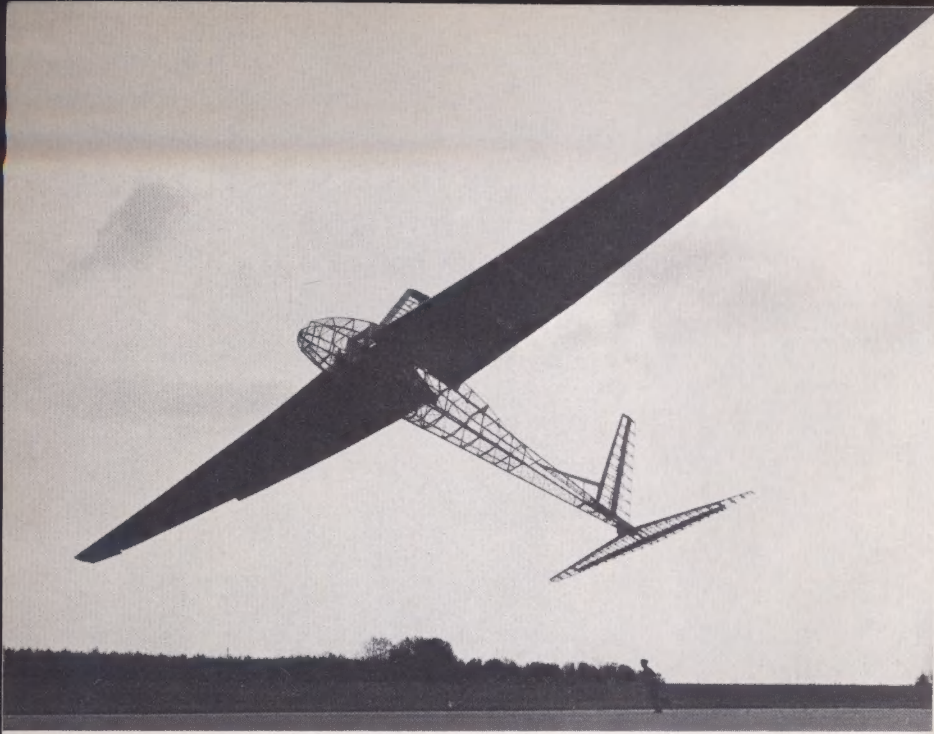
SCIENCE DIGEST

FEBRUARY 1966 50 CENTS ICD

ARE CHIMPS REALLY ANIMALS?

JANE GOODALL'S 5 YEARS WITH HER JUNGLE FRIENDS

Also:
- Coming soon: world's first artificial baby
- What new E.S.P. experiments reveal
- How we can delay old age
- Blackout lessons for the utilities and for you
- Spare hearts are already here
- How to get a science job overseas—and at home



Pictorial Parade

Pedal plane

HERE WE go again, trying to fly by our own power. The story this time went like this:

Alan Lassiere, 26, of Thornton Heath, Surrey, England, had begun building a cycle-plane five years ago at Southampton University. He was out to win a standing prize of 5,000 pounds sterling for the first person to design a self-propelled aircraft to fly a mile.

Then, on November 13, his pilot, John Pratt, put his feet on the pedals at West Malling RAF station, Kent. It was like no performance you might expect on an RAF field.

Pedalling furiously, with two helpers holding the wings straight, Pratt got the contraption hurtling down the runway.

At last, it got airborne. Sure it was only just above the ground, but it was flying. Then it lunged to a 30-foot altitude.

Suddenly it seemed about to turn over. Instead, it stalled, dipped its 30-foot starboard wing and slewed to the ground.

The wing splintered, the tail came off, the bicycle wheel buckled and Pratt's metal-frame cockpit was twisted out of shape.

Pratt himself emerged from the wreckage without a scratch.

Total distance covered during the flight: just over 50 yards.

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THIS MONTH

You read us. Do we read you? We ask the question because: 1. At this writing, it was one year ago that you saw the first issue of *Science Digest* edited according to a carefully worked out new plan. 2. We think this plan suits you fine, or at least better, because more of you are buying this magazine than before.

But readers are notoriously unexpressive, and that makes editors notoriously frustrated. We research and write and edit and illustrate and with pressing regularity put together a magazine that talks to you. Presumably you hear us. But how? Or to what extent? What do we mean to you?

Forgive us if we feel a little like someone talking to a wall.

We're not blaming you. We're readers of other magazines, too, and *we* don't do much more than play wall to *them* either.

Here's the point: We believe that educated people today really want to keep abreast of the great surge forward of science and technology. Every day, it involves them more and more. We try to meet that desire two ways: 1. We give you straight, hard news of what happened in science the previous month (and it's plenty). 2. We tell you what it means.

We hope, as you read this issue, you'll find we're reading you.

—The Editors

SCIENCE DIGEST

The science news monthly

After five years in the jungle, Jane Goodall, a remarkable young English scientist, has found that chimpanzees are far more like men than we had ever dared imagine. A story and picture report on her work begins on page 58.

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SCIENCE THIS MONTH

SCIENCE PANORAMA

SCIENCE MISCELLANY

FIRST RENDEZVOUS IN SPACE. Walter M. Schirra broke out into a wide grin (above) and so did everyone else connected with the U. S. space effort. With Thomas P. Stafford as his co-pilot, he had steered Gemini 6 in the vastness of space to within 6 feet of Gemini 7 (see page 20).

It was an achievement rated as the most significant since John Glenn became the first American to orbit the earth. And it was the most complicated ever attempted.

Significance of the rendezvous lay in the fact that without such a capability, there will be no manned flight to the moon. The U.S. plan is to send a vehicle to the moon and detach part of it for the landing while the remainder stays in lunar orbit. To return to Earth, the moon men will blast off and rendezvous with the circling portion. They will transfer to it and start on their last leg. The Russians will blast off from the moon in a direct flight to Earth but, to get to the moon, will rendezvous in orbit around Earth to assemble their ship.

Complexity of the rendezvous lay in the curious effect of Sir Isaac Newton's basic laws. They say that an object in orbit is subject to two forces--gravity and the impetus of its forward speed. An object in a low orbit feels the pull of gravity more and so must travel faster. In higher orbits, it's pulled by gravity less and it travels more slowly. When Gemini 6 took off, it was 1,400 miles behind Gemini 7 but in a lower orbit, which meant it was traveling faster. In successive orbits, as it caught up with Gemini 7, Gemini 6 eased up into higher and higher altitudes. The effect was to slow it down until, when it reached Gemini 7's orbital altitude, the two craft were alongside each other.

The maneuvering was made possible by the Geminis' thruster rockets, which work with forward, backward and sideways effects. As 6 and 7 accompanied each other twice around the earth, their crews pirouetted their craft around each other with short thruster "burns." It was a demonstration of confident capacity to handle perhaps the trickiest part of man's coming voyage to the moon.

OTHER SPACE SHOTS: 1. France orbitted its first satellite from Algeria--a simple vehicle emitting radio signals. 2. Russia's soft-landing Luna 8 crashed on the moon. 3. U.S. sources said a third Soviet Venus probe in 11 days failed. The first two, Venus 2 and 3, got off successfully.

SPACE AND POLITICS. NASA cut back its scientific program for budgetary reasons. A victim: the Orbiting Solar Observatory.

LEARNING BY INJECTION. Learning ability has apparently been transferred between two species of animals by the injection of ribonucleic acid (RNA). A team of California scientists reported that they had taken RNA from the brains of trained hamsters and injected it into rats. Tests then showed that rats that received injections learned the tasks that had been taught the hamsters much faster than rats that had not received injections. The theory behind the experiments is that RNA molecules, present in all brain cells, carry memory. When a new memory is acquired the arrangement of these molecules changes, and memory is retained through these "coded" molecules. The theory, however, is still controversial, and the California group admits its tests are not yet conclusive.

SCHIZOPHRENIC PRONE. The bizarre thinking process of the schizophrenic may be linked to a disordered function of the involuntary nervous system that regulates digestion, circulation and respiration. In studying pre-schizophrenic children, Dr. Sarnoff Mednick of the U. of Michigan found that they react more quickly and powerfully to mild stress, such as a loud noise. They also recover faster after an upset. The involuntary nervous system regulates emotional reactions such as fear and anxiety.

LINSEED OIL DIET. A researcher who stated that a tablespoonful of refined linseed oil each day had been shown to reduce heart attacks has now found that further studies contradict his early results and that linseed oil "cannot be recommended."

MOST DISTANT QUASAR. Astronomers have identified the quasar 0106+01 (a number indicating the object's location) as the most distant known object in the universe. This is the third time in the last two years that the range of observation has been extended. Most scientists believe that the more distant an object is from earth the faster it is receding. Dr. Margaret E. Burbidge of the U. of California announced that the new quasar was receding at 81 percent the speed of light. This is slightly faster than the quasar 3C-9, which last May was reported to be receding from earth at 80 percent the speed of light.

BLUE GALAXIES. Several months ago Dr. Allan Sandage reported finding numerous distant astronomical objects that differed markedly from ordinary quasars. He called them blue galaxies. Further study has shown that most of these objects are really nearby stars and not more than 10 or 20 percent are really as distant as quasars.

FIREBALL. A fiery object streaking through the sky over northern states in December set off a rash of flying saucer and U.F.O. (unidentified flying object) reports. Astronomers, however, did not allow it to remain unidentified for long. They agreed it was a fireball, an unusually large meteor that throws off blazing bits of material as it speeds through the atmosphere. The fragments apparently caused scattered minor fires in Ohio and Pennsylvania. In Michigan strange metallic fragments were found. The Air Force flying saucer group planned no special study.

ANTIPROTONS CREATED. A German-American team of scientists converted pure energy into matter. Using a beam of gamma rays they produced an equal number of protons and antiprotons. It was the first time antiprotons were ever generated in this manner. As with most experiments in this realm of basic physics, the antiproton experiment has no obvious practical use. Said one scientist, "These men may have done something quite important. They have added to our understanding of antiprotons, protons and the nucleus. They have thus added to our understanding of the universe, and perhaps beyond. But as far as earth is concerned, it's hard to see any practical value."

LIFE ON MARS? Dr. Stanley Miller, a chemist who specializes in determining the way in which life was originally synthesized, spoke out against the view that the pictures of Mars taken by Mariner 4 make the existence of life there unlikely. The photos, he said, revealed "absolutely nothing" that bore on this question. His view was backed by Dr. James R. Arnold, who said that Mars had been hit by large meteorites some 25 times more often than the moon. Thus, the many craters on the surface do not mean the planet was never eroded by water, since they could have been produced in a comparatively short time.

DEEP SEA PLANT LIFE. A U. of Miami marine biologist, Prof. E.J.F. Wood, reported finding algae living 12,000 feet below the surface of the ocean. Previously it had been believed that plant life could not extend much below a depth of about 240 feet.

Highest arch in the U. S.

How do you guarantee the tallest structure in town won't fall down?

Engineers in St. Louis wanted to check every welded seam in the 630-foot-high arch symbolizing St. Louis, "Gateway to the West."

Every Saturday, weather permitting, from January, 1963, to the arch's recent completion, two X-ray technicians acted like human flies and climbed to the top with an Iridium-192 "gamma ray projector." This device sends gamma radiation—similar in wave length and penetrating power to conventional x-rays—through solid substances and projects a radiographic image of the solid steel's interior on x-ray film.

Each week one radiologist would climb inside down the hollow leg and tape industrial x-ray film to the inside of the welded joints. His companion, located on a wood platform on the leg's outside, aimed the gamma camera. They communicated with each other by rapping out Morse code signals.

Each had to get out of the radiation field before the gamma projector was turned on. To make the exposure, a crank-and-cable remote control system moved a radioactive iridium pill out of its shielded storage container.

The inner carbon steel and the outer skin of stainless steel support the gravity and wind loads. The arch is designed to withstand winds of more than 150 mph.

Although the joints could be checked by x-ray, engineers were plagued with temperature distortions. While some parts of the arch were in the shade during construction, other parts were absorbing sunlight, causing one leg or the other to go out of line. Last winter one leg moved out of line by three inches. However, these problems were overcome and the arch is now complete. Topped with an observation platform, it is the tallest arch in the U.S.

U.P.I.

The only lights visible in this picture of New York City on the night of Nov. 9 are, the moon, lights on ships in the harbor and one hospital that had an emergency generator.

What the blackout taught us

by Bruce H. Frisch

If your first curse in the dark of November 9 was, "There ought to be a law," the Federal Power Commission will back you up.

The FPC reminded the President in its report on the blackout that the Federal Power Act of 1935 concentrated on controlling the *cost* of electricity. Perhaps now the Federal government should also watchdog "the *continuity* of service."

That's lesson No. 1.

Lesson No. 2 helps explain why the blackout was so big. It is: There was more than one failure, there were many. Let's go back to Queenston, Ontario, where it began, in the switchyard of the Sir Adam Beck Generating Station No. 2, a hydroelectric plant on the Niagara River.

Out of the switchyard, run six power lines. Five are heavy, long-distance lines going west or around the end of Lake Ontario to Toronto. Into the yard, run lines from the generators of Beck No. 2, some of the generators of Beck No. 1, and two lines from the United States.

At 5:15, a total of 1,745 Mw (megawatts, millions of watts) was going out of the yard, of which 1,245 Mw was being turned out by Beck and 500 Mw was coming from the U.S.

At 5:16:11 the trouble started. One of the big lines going west was automatically disconnected. The line was built to handle 500 Mw, but in 1963, in accordance with power demands at the time, a relay was set to trip a circuit breaker on the line when the load reached 375 Mw. Since then, demands had crept upward until the normal peak load on the line was only about 19 Mw away from the panic point.

But Ontario Hydro had forgotten to raise the setting. On November 9, a brief ripple in demand carried

the load over the setting, and the relay ordered the circuit breaker open.

Normally, automatic controls should have isolated the line; instead, the load was thrown onto the other four big lines. They couldn't carry the extra burden, and tripped out also. Ironically, the local line sailed through intact, and the immediate area remained an island of light. Now there was nowhere for the tremendous power of the Beck plant to go, except through the ties to the U.S.

Within 2½ seconds, the flow of power through the ties reversed from 500 Mw going west to about 1,030 Mw going east. Relays and circuit breakers guarding these lines should have shut them off when the surge reached 864 Mw, but they didn't. The relays were designed to work after an overload had continued for a preset length of time. The surge lasted about a second, not long enough to trip the relays, but long enough to topple more than five states.

Whereas the turbines in western New York had been straining to supply their own areas and generate a 500 Mw surplus for export, they were now abruptly relieved of the 500 Mw load and given a 1,030 Mw shove by Beck. If your car were pulling up a steep hill, and you pushed in the clutch, the engine would race. Well, the turbines and generators raced. But all generators east of the Rockies are set in lock step. If two generators are out of step, the voltage in one goes up while the voltage in the other goes down. They fight each other, instead of pulling together. Before

During the blackout only half of New York City's hospitals had emergency power. At the Albany Medical Center operations were performed with light from one portable generator.

U.P.I.

Airports had alternate sources of power, but they also died.

the generators could battle each other into junk, protective devices severed them from the system.

The homes and factories they served, however, were still connected to the grid and began sucking power out of neighboring systems. The sudden, giant call for power was more than the neighbors could handle. It simply had the effect of slamming the brakes on their generators. Power companies to the east of western N.Y. started falling like dominoes. At 5:21, the line of collapse passed Boston and turned south. The last to fall was the Long Island Lighting Co. at 5:28.

Of course, this is not the way it was supposed to be. All along the way, there were points at which machine and human judgment should have cut systems free of the grid. The rules of the grid do not demand that a system give up its life.

But they died like flies. The picture that emerges is not of the CANUSE (Canada-United States Eastern Interconnection) grid as a rocklike fortress with one weak spot, but of a rickety, rambling barn. The FPC devoted 11 of its 19 recommendations to shoring it up.

Next lesson. At 5:27, Capt. Carl Loftstedt banked his DC-8 into a right turn toward the lights of Kennedy International Airport. On the flight from Copenhagen, were 11 crew members and 88 passengers. Loftstedt glanced down at his instruments, looked up. The airport was gone. Luckily it was a clear, moonlight night, and Newark Airport had lights. He landed there.

For 12 hours, Kennedy was completely closed. La Guardia rigged some impromptu lights to an emergency water pumping generator. Boston's Logan Airport had battery lights set up in an hour. About 200 planes had to be diverted from the three airports to as far away as Bermuda.

The Federal Aviation Agency acted quickly to send emergency generators to Kennedy and La Guardia and started a plan rolling to equip 25 of the nation's "hub" airports with standby power.

But the question remained: Why weren't they outfitted with auxiliary power in the first place? The answer was: They were. However, instead of equipping the fields with generators, airport designers have been taking the cheaper measure of bringing in lines from alternate commercial sources, on the theory that if one went out, they could switch to the other. Kennedy had three sources; La Guardia, two. All went dead.

Out of 855 hospitals in the blackout area, almost all had adequate emergency power, except for about 75 of 150 hospitals in New York. The Metropolitan Hospital had to store its blood supply in the Ruppert Brewery. As a result, municipal hospitals, at least, that didn't

already have auxiliary generators will get them.

On New York's Park Avenue, the Union Carbide Building shone alone on its own emergency power. Should every large office building be so equipped? A bill submitted to the New York legislature would require a standby generator in every apartment house over five stories tall.

Airports and hospitals, yes. Office buildings and apartment houses is going too far. After all, a grid has two main purposes, to help a system in trouble and make electricity cheaper. The catch is that if it can't reliably do the first, it can't do the second.

Savings result from sending cheap hydro power to remote places through the grid. Savings result when adjoining systems build one big, efficient plant they can share, in place of two small plants operating independently. And savings result from each system's having to own less reserve capacity, because it can call on the grid. But if the grid breaks down every time you breathe on it, people are scared into buying emergency generators. Where are the savings then, when

How you can prepare for a blackout

Follow these five points to be prepared for the next blackout. Remember that the FPC said, "We are unable to say that another blackout of similar magnitude is impossible."

1. Buy a transistor radio. About half the radio stations in the country have emergency power, so can broadcast during an outage, according to the Federal Communications Commission. The New York City Police Department is considering giving transistor radios to all its 27,000 men.

2. Check your knowledge about frozen foods. If there are ice crystals on the outside of the package, the food is still safe for keeping. If not, use immediately, or cook, then refreeze. Open the refrigerator or freezer door as little as possible while power is out.

3. If you depend on well water, it may be worthwhile to rig up a hand pump you can use when the electric pump goes dead.

4. Look into "total power" systems, if you use a sizeable amount of electricity. You'd own your own generator fueled by oil, diesel fuel, natural or bottled gas. Waste heat goes to space heating, steam, heat for a manufacturing process or for air conditioning. Overall, your costs may be lower than if you bought power from a utility, had a separate boiler and so forth. Smallest size: 15 kilowatts.

5. Keep a stock of candles, or, preferably, *fresh* flashlight batteries. Put a can of gasoline in the trunk of your car. As stranded motorists learned during the blackout, pumps at service stations do not work by hand.

instead of the utility's owning the reserve, its customers own it?

Lesson No. 3, therefore, is that a grid is 100 percent reliable or better off disbanded. "99.9+ percent" is not enough, the FPC said, and chose to strengthen the grid rather than dissolve it. At present, it concluded, CANUSE is "not a true power pool."

A further lesson was extracted from the blackout by *Life* magazine. "Unreasoning computers" egged on the collapse, it said. Therefore, "people . . . must control machines."

The fact is that human judgment had its biggest chance at the Con Edison Energy Control Center, and flubbed.

Plonked in front of yards of instruments and a diagram of the system outlined in lights, the chief operator, guardian of power for 15,000,000 persons, first knew there was trouble when "the house lights dipped severely." He had about ten minutes to order pushed the eight buttons that could save New York from disaster.

He called for an instrument check. He took three calls from power plants. He called Syracuse. Finally he gave the word. As the first buttons were being pressed, the lights went out entirely.

Wasn't he maybe just a tiny bit in error? Certainly not, said Harland Forbes, board chairman of Con Edison. He would have taken the same action himself.

But computer and automation men interviewed by *The New York Times* called for more computers. They pointed out that human operators tend to first disbelieve the instruments (the instrument check), then hesitate about taking such a serious act as cutting loose from the grid. A computer believes and acts instantaneously.

The time for human judgment in the grid is beforehand, in the designing.

Yet after the blackout, the power companies of the Northeast grid and their engineers were defended on the shaky grounds that "no system was more studied and then restudied to prevent from happening just what did happen."

Well, when the FPC issued its report, it picked the grid apart (and the member companies). And as a machine, the grid is just an extension of the engineer. Don't flog the machine. If a statue is a dud, no one blames the clay.

THE PROGRESS OF MEDICINE

Visual cripples in sports

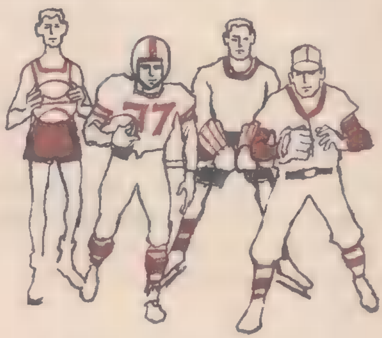
by Arthur J. Snider

TODAY'S athletes tend toward a higher I.Q. but a lower Eye-Q. A Seattle optometrist is finding an increasing number of visual cripples in competitive athletics. His estimates, based on spot checks, indicate that at least 20 percent of athletes competing in high school, college and professional sports have some optical deficiency.

In the rookie spring training camp of the Boston Red Sox, Dr. Wayne F. Martin found that 13 among the 135 aspirants needed glasses. "Many were unaware of how poorly they were seeing," he points out. "One young player from Texas, trying for first base, had 20/70 vision in each eye. He said he had always depended on his brother to read street signs for him but now he guessed he was on his own."

In addition to the 13 unsuspecting near-sighted players, six others needed their glasses strengthened to provide 20/20 vision. Five owned glasses but never wore them. Four wore glasses full time and two others, only when they played. Five wore contact lenses full time. Additionally, 10 had adequate visual acuity but lacked binocular balance. Of these, only five could be helped by a visual training program.

As a visual consultant to the University of Washington varsity teams, Dr. Martin fitted two baseball players with contact lenses during the 1965 season. Both raised their batting averages, ranked one-



two in hitting and were chosen for the Northern division Pacific Coast All-Star team.

Eighteen men made the University of Washington football team with contact lenses. A Seattle University basketball player who complained he could not see the scoreboard or clock was chosen as an all-American after putting on lenses. A hockey player for the Seattle Totems, who couldn't see the faces of his fellow players across the ice and had to wait for team-mates to holler when they wanted a pass, was fitted with contact lenses and became a star. But you don't have to be an athlete to benefit from lenses.

There are about eight million Americans who own contact lenses, according to Dr. David Miller of the Massachusetts Eye and Ear Infirmary. Most people who turn to them feel that wearing spectacles detracts from their appearance or interferes with their activities. But there is a second group of wearers who have eye conditions that cannot be corrected by conventional glasses.

Dr. Miller's colleague, Dr. Perry Rosenthal, says the decision to obtain contact lenses should be made only after the patient is made aware of their potential inconveniences. Although many failures are due to poorly fitted lenses, the contour of a certain percentage of corneas is such that even well-fitted lenses do not allow enough tear exchange for them to be well-tolerated.

The discomfort of getting used to them, the necessity of removing lenses during swimming or sleeping, and the frequent lodging of foreign bodies under the lenses, especially on windy days, are experienced by all wearers of corneal contact lenses.

Serious complications resulting from the wearing of contact lenses are fortunately rare, Dr. Rosenthal says in the *New England Journal of Medicine*. The most serious is a corneal scarring, an infection usually resulting from storing lenses in cases contaminated with bacteria. Permanent corneal scarring due directly to the trauma of poorly fitted lenses is uncommon. Corneal abrasions caused by the overwearing of contact lenses always heal without visual impairment, although they are often painful.

When a contact lens is inserted for the first time, immediate discomfort is experienced, but this decreases somewhat after a few minutes. After the lens is worn for increasingly longer periods, the tearing and sensitivity to light subside gradually, until ideally the lens can be worn throughout the waking hours without the patient's being conscious of its presence.

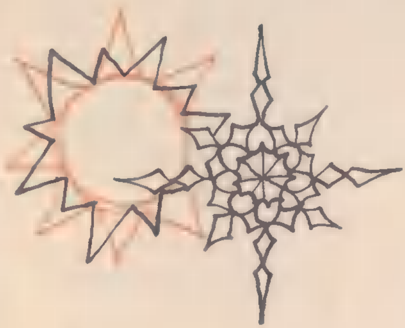
Even a well-fitted lens interferes with corneal metabolism if worn for too long. Some patients develop an insensitive cornea; that is, the normal alerting device that tells when a piece of foreign matter is scratching the cornea no longer functions. An unheeded abrasion of the cornea can develop into a serious infection. Experts advise contact lenses wearers to investigate all eye irritations and have their eyes checked periodically.

Ulcers all year 'round

Is peptic ulcer a "seasonal" disease? Some medical investigators have put forth the hypothesis that peptic ulcer patients are most likely to develop symptoms in the spring and fall. But a study by Dr. Manuel Tzagournis of Ohio State University refutes this.

Dr. Tzagournis reviewed the clinical records of 751 ulcer patients hospitalized during a three-year period at the University Hos-

pital in Columbus. He found that 27.8 percent of the patients were admitted during the winter, 26.4



percent during the spring, 23.4 percent during the summer and 22.4 during the fall. The differences are not statistically significant.

New hope for diabetics

The goal of diabetes investigators is the ultimate prevention of the disease. Never has the outlook been more hopeful, according to Dr. Theodore Schwartz, chairman of the department of endocrinology and metabolism, Presbyterian-St. Luke's Hospital, Chicago.

Among the important research clues:

• There is growing evidence that many diabetics may not have a deficiency of insulin but rather an insulin "antagonist" in the system that neutralizes or destroys the normal output. If the antagonist could be shut down, the body's normal production of the hormone would be sufficient to perform its task of maintaining a proper blood sugar level.

• There appears to be a prediabetes state detectable with sensitive tests. Should this be confirmed, it might be possible to postpone or prevent the onset of permanent diabetes.

• The pancreas may not be the only producer of insulin. A substance behaving much like insulin has been found to be produced by the thymus gland, located beneath the breast bone.

• The prospect for transplanting a healthy pancreas is favorable if the problem of tissue rejection can be overcome. Several such transplants in animals have been successful for periods of time.

• Cracking of the genetic code may one day make it possible to correct the hereditary defect in diabetes.

Appendicitis slump

Appendicitis has become a less frequent disease in the last half-century. No one knows why. Some have suggested the possibility that appendicitis might be a disease of cyclic incidence. Others believe a change in national dietary habits might be responsible, and still others, that the widespread use of antibiotics for other purposes is having the long-term effect of preventing appendicitis.

While appendicitis is apparently not being observed as often, burst appendix is again making its ap-

pearance, warns Dr. William C. Beck of the Guthrie Clinic, Sayre, Penn. If it is a trend, he adds, it must be stemmed by the same methods so successfully employed two decades ago.

"This means lectures, articles in the lay press and through other mass educational media," Dr. Beck advises. "It means re-education of our profession. Physicians must again become suspicious and again be warned about the dangers of the disease. Probably most important is the recognition of the fact that appendicitis can attack others than teenagers. It must be considered in all of the acute abdominal episodes of the very young and even the very old."

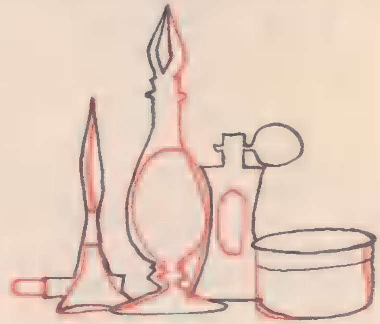
Dr. Beck suggested that the appendix be removed if possible when the abdominal area is opened for other reasons.

Why women make up

She's a female type known as "the doll." Her signature is her overwhelming makeup. She's laden with eye shadow and mascara.

The over-cosmeticized doll, a skin physician says, is a woman seeking a sense of identity she did not receive early in life. The identity normally derived from the mother was confused. The mothers pushed their daughters to be better than themselves.

"As a result," explains Dr. Milton Robin of Chicago, "these girls gravitate in their thinking and fantasy life to alluring, idealized figures. Unreal substitutes, such as pictures of models in ads, come to represent their image of themselves. Since striving to look like these idealized models does not give any real fulfillment, the dolls use cosmetics more and more in an unrequited search to find themselves."



The vast majority of women, however, do not use cosmetics in a neurotic way, Dr. Robin finds. On the basis of a questionnaire given to 75 females, ages 15 to 50, he found that most women used cosmetics to be admired by other women and to attract the male.

Very few women were satisfied with their natural appearance. They felt a need for reassurance.

As one woman said: "I wear makeup because otherwise my husband says I am odorless, colorless and tasteless. I feel more sure of myself with makeup on."

Women who wanted to be admired by other women noted that society demands conformity. "I don't care about cosmetics for myself," one replied. "I wear them for

other people."

Several noted that cosmetics give them a lift when they are unhappy.

"The therapeutic effect of cosmetics on women has been noted in hospitals," Robin says. "A surgeon told me that when he walks into a post-operative room and the woman is wearing lipstick, he knows she is on the road to recovery."

Workers who get sick

"Hello, Foreman? This is Louie. I took sick last night and the Doc says I gotta stay in bed a couple of days. He's coming out again Friday, though, and if the medicine he left does any good, he'll let me come back Monday. Sorry."

Dr. David Joe Smith, medical director of the U. S. Steel Corporation's Southworks plant, says variations of this sick call take place 7,000 times a year in his plant and result in more than 84,000 man-hours of work absence.

In a study of the absentee problem, Dr. Smith derived these findings:

- About one fourth of absences last only one day. About one half are three days or less and three-fourths are no longer than a week.
- More than half the absences were caused by colds and other diseases of the respiratory tract and by upset stomachs and other diseases of the digestive system.
- Women are absent more often than men and remain away longer.
- Salaried employees are absent more than management and people paid hourly.
- A few individuals in the large group are "illness-prone" and miss work longer and more often than their fellow workers. Among these are the alcoholics.
- The better the weather, the better the attendance.

A disturbing note: "For a while, the absence rate of the young employees was quite low, at least until the end of the probationary period. But recently we have noted immediate, repeated and even prolonged absences among them," Dr. Smith reports.

"This is disturbing both for the present and the future, since we have found that once the pattern begins, it is likely to continue."

New rubella baby peril

A new public health problem is posed by the discovery that babies born to mothers who had been afflicted with German measles (rubella) may themselves transmit the disease.

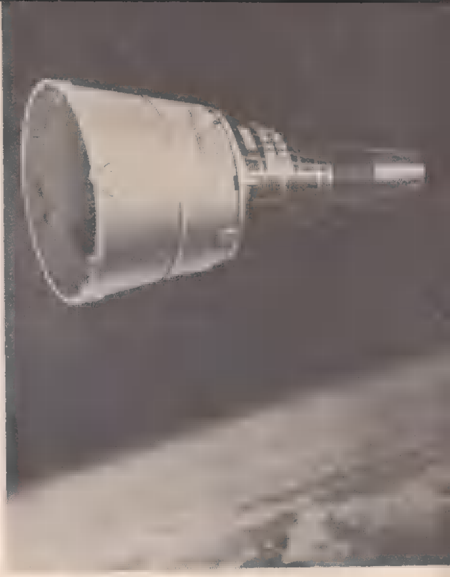
The infants continue to harbor the rubella virus for some time after birth. Dr. C. Alan Phillips of Baylor University has found it present for up to nine months.

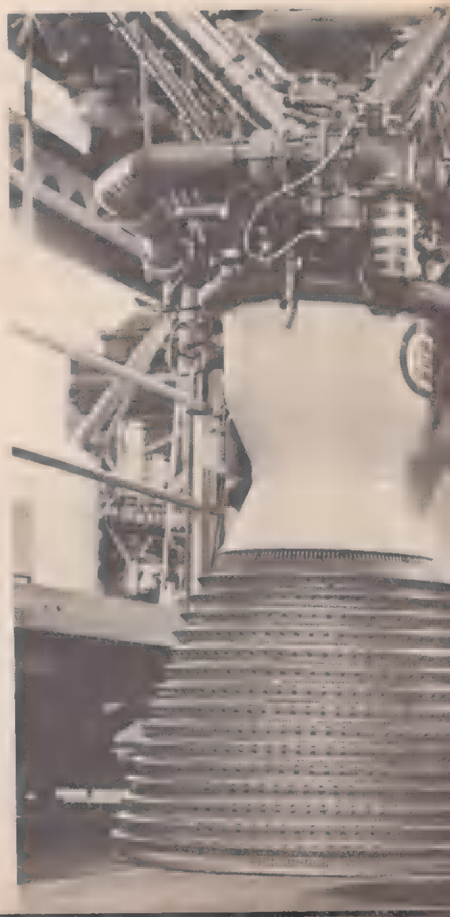
The infected infants are a particular hazard to women in the first three months of pregnancy if they have not previously had rubella. Dr. Phillips said it would be advisable for the new mother not to invite the neighbors in to see the baby.

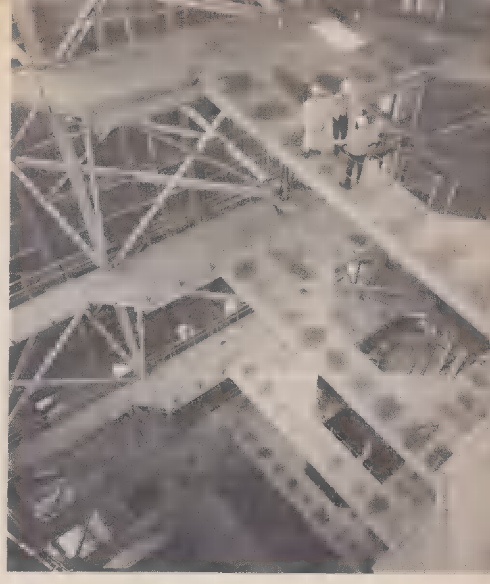
THE SPACE PICTURE

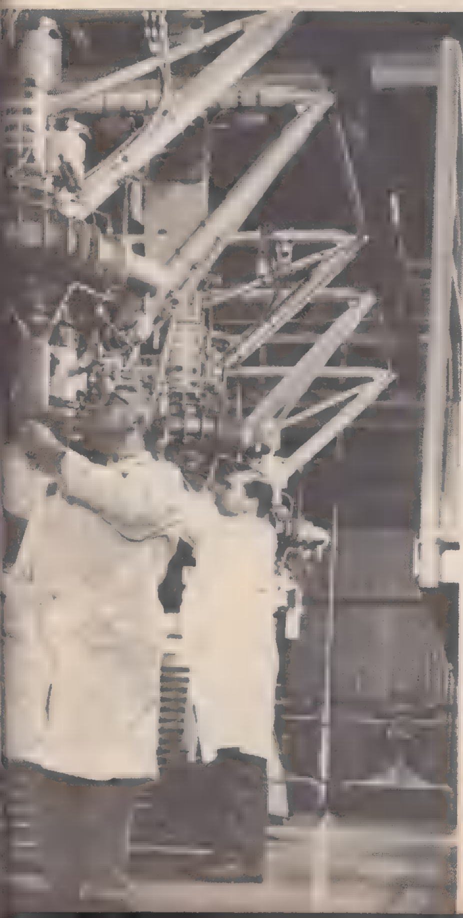
How to meet in orbit

Right: The historic space rendezvous of Gemini 7 and Gemini 6 is depicted in this artist's conception, as they came together in their dual flight. After the meeting, Gemini 7 astronauts Frank Borman (top, below) and James A. Lovell, Jr. (bottom) continued their 14-day mission in space, shattering all records of time spent in orbit. The mission indicated man can endure prolonged weightless flight, but full study won't be complete for months.





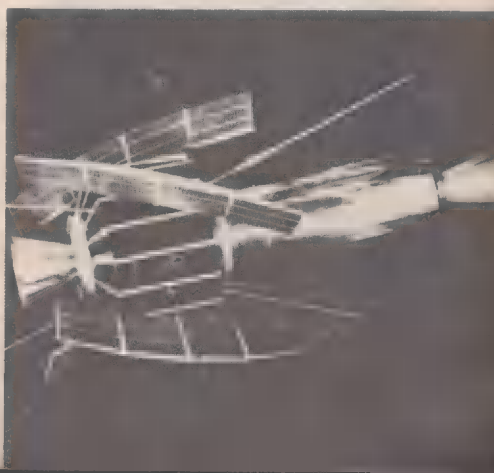




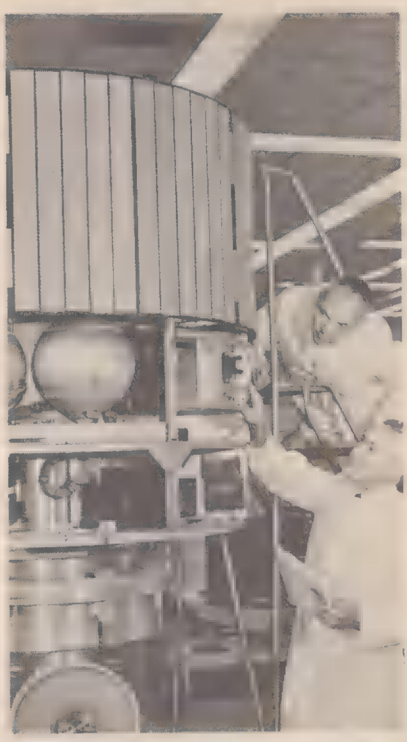
Above: Technicians stand on a work platform inside the giant new test stand at the Spaceflight Center, Huntsville, Ala. The 365-foot-tall Saturn V launch vehicle was placed in this stand for "shake" tests to find bending, vibration characteristics.

Left: Space flight has moved from the single model to the assembly-line stage. Rocket engines for the Titan rocket that launched the two-man Gemini spacecraft into orbit are shown on the production line in the Aerojet General Corp. plant.

Below: Flying antennas, as long as 1,500 feet, will be orbited to pinpoint sources of celestial radio signals. Scale model shows Radio Astronomy Explorer, before deployment of two 750-foot antennas to be mounted opposite each other.



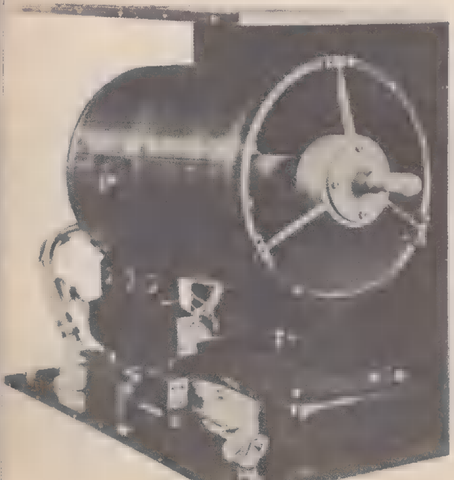
The Applications Technology Satellite or ATS (right), the first of which will be launched this year, could be described as a spin-stabilized, synchronous orbit space "omnibus." This means that the ATS will employ a concept similar to the principle that causes the moon to rotate once during each orbit of the earth, to keep one side facing the earth's surface constantly. It will hover over a spot on the equator (synchronous equatorial orbit). The vehicle is an "omnibus" because the 1550-pound satellite will carry enough equipment for twenty separate scientific experiments.



Cameras that spin

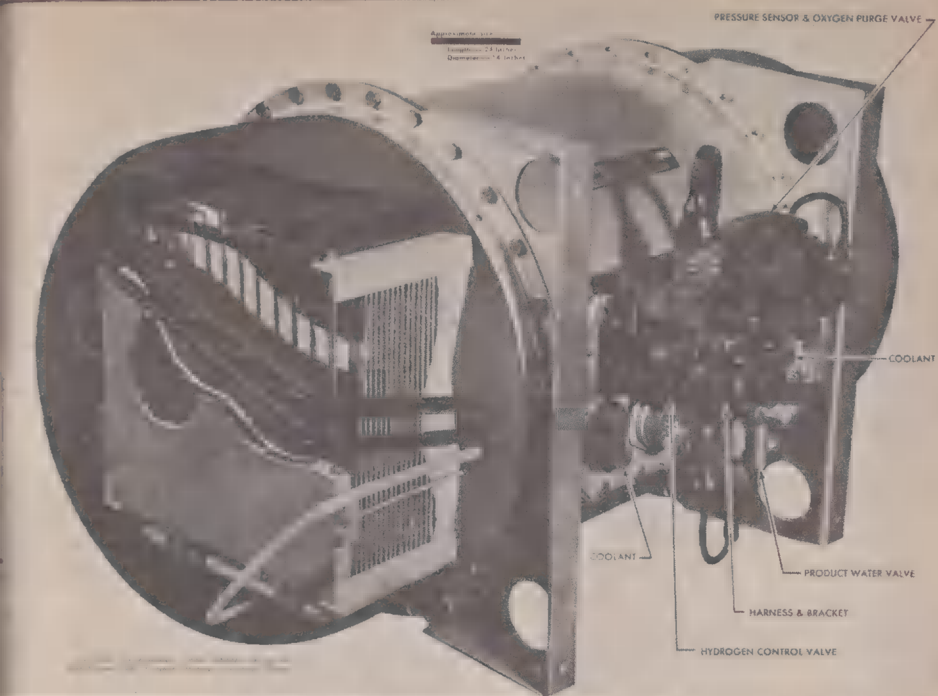
A meteorological experiment on the first ATS will test a high-resolution, spin-scan camera system (below). It will, for the first time, produce cloud pictures from synchronous altitude. This will provide continuous observation of cloud motion and give weathermen a much better understanding of weather circulation. The east-west scan by the camera will be generated by the spin of the craft, the north-south scan will come from a mechanical movement of the camera itself. Photos from the spin-scan camera will differ somewhat from conventional photographs (below right).

CONVENTIONAL PHOTOGRAPH



SPIN SCAN CAMERA

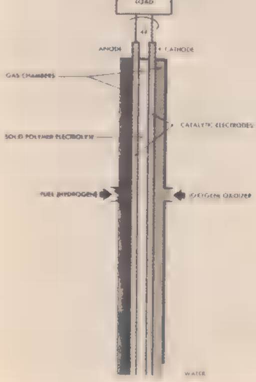
SPIN SCAN PICTURE

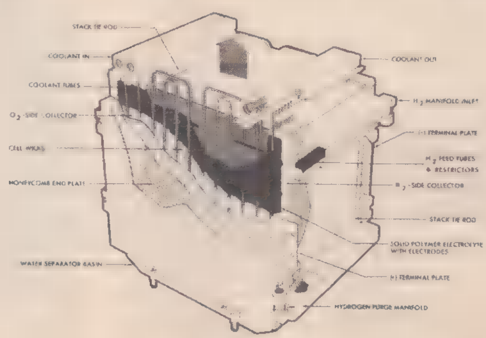


Cut-away model shows interior of fuel cell battery unit used in the Gemini spacecraft. The unit contains 96 individual fuel cells in three stacks and delivers up to 1 kilowatt of power. This type of system is unusually good for spacecraft because it requires no auxiliary equipment other than the supply of reactants and a means of coolant circulation.

Instant space power

The main element of the fuel cell (left, below) is a thin but tough sheet of plastic electrolyte to which metallic electrodes are bonded. Hydrogen fuel and oxygen are continually supplied to opposite sides of the cell. Individual fuel cell assemblies are arranged in modular units (right) and electrically connected in series for needed voltage.





THE GEOLOGY STORY

New clues to life's beginning

THE EARTH'S crust was formed 4.5 billion years ago, according to present theory. From that time until the beginning of the Cambrian era, 600 million years ago, there is almost no fossil record of when life began and how it evolved. Then, suddenly and dramatically in rocks from the Cambrian era, fossils representing most of the major divisions of the plant and animal kingdoms appear.

One of the major problems in evolutionary theory is explaining how so many diversified and complex forms could appear so quickly without a preceding fossil record. One theory advanced to explain this apparent "evolution explosion" is that 600 million years ago there was a dramatic change in the earth's environment as oxygen was introduced as a free component of the air. This made it possible for organisms to produce energy more efficiently and required more complex structures. This change resulted in evolutionary progress so rapid that there was little time for an extensive fossil record to accumulate.

The fossil darkness of the Precambrian era was lighted recently by two reports delivered at meeting of the Geological Society of America. The discovery of fossils in rocks three billion years old was announced by Elso S. Barghoorn, professor of botany at Harvard. Prof. Barghoorn's discovery pushes the date of the emergence of life back to a time when most scientists had believed the earth would not support life of any kind.

For the last few years, Prof. Barghoorn has been engaged in the tedious and often frustrating search for Precambrian fossils. Often in the past, scientists found what appeared to be fossils of simple plants or animals from the period, but further examination showed that almost all were some form of inorganic matter. Then in 1961, Prof. Barghoorn found coal in Michigan that was dated at 1.7 billion years—the oldest known evidence of life to that time. Later, others found evidence of life in 2.7 billion-year-old rocks.

Prof. Barghoorn's latest discovery was made in rocks from South Africa. These rocks, believed by geologists to be very ancient, were brought to Harvard, where Prof. Barghoorn studied them with the aid of a powerful microscope. What he found in them were rod-like objects that resemble modern bacteria. If the discovery holds up, the emergence of life from inorganic matter will be pushed back to a mere (geologically speaking) 1.5 billion years after the theoretical

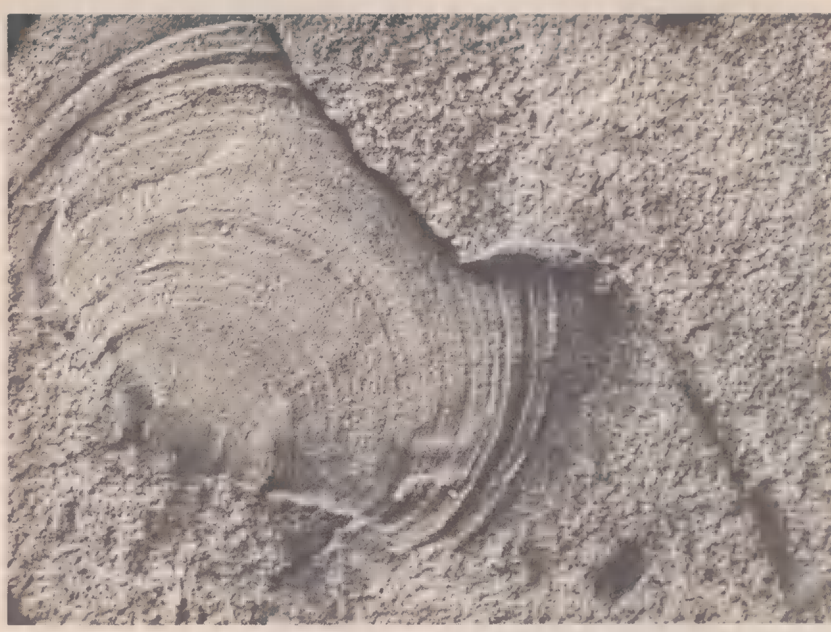
Above: Prof. Andrew H. McNair with one of his 720-million-year-old fossil animals. Below: Harvard's Elso S. Barghoorn, who found traces of three-billion-year-old life.

formation of the earth's crust.

A second discovery announced at the meeting may lengthen the known history of complex animals 20 percent, and severely shake the "evolution explosion" theory. Dartmouth geologist Andrew H. McNair announced that he and his associates had found the first complex organisms in Precambrian rocks. In a grueling expedition to the Northern Canadian island of Victoria, the Dartmouth team found fossils of clamlike creatures called brachiopods and worm burrowings in rocks believed to be at least 720 million years old.

One of the greatest difficulties in searching for Precambrian fossils is finding places in the world where unaltered Precambrian rocks are near enough to the surface for examination. Both Victoria Island and the South African site are geological freaks. The exact age of the Canadian rocks is still a matter of dispute. A firm that specializes in radio-isotope-dating first set the age of the Victoria fossils at 720 million years, later stated that it had found a computation error. The correct minimum age was 455 million years, it said. The Dartmouth geologists, however, believe that so young an age is "geologically impossible." They point out that 455 million years is only the "minimum age." "It's like a middle-aged woman saying she's over 21. It's true, but hardly relevant," snorted one geologist.

A problem with this type of dating is that it can set a minimum age



Fossil clam-like brachiopod was found in Precambrian rocks. The animal looks simple, but it is by far the most advanced form of life ever found from such an early period.

but cannot set an exact one.

Prof. McNair is now having other tests made. "We were entirely ready to accept the 720-million-year figure because it fitted in nicely with other geological evidence," he said. Included in the other evidence are rocks younger than those in which the fossils were found, whose minimum age has been set by radioisotope-dating at 640 million years.

If the Victoria Island rocks ultimately prove to be 720 million years old or older, it will suggest that there has been an ample supply of free oxygen in the air for a much longer period than previously believed. And the three-billion-year-old fossils indicate that the earth's atmosphere stabilized, oceans formed and the earth's surface began to resemble its modern form far more rapidly than present theories allow.—*D. C.*

Fossilized burrowing of 720-million-year-old worm, on Canada's Victoria Island.

INVENTOR OF THE MONTH

He shoots ink through the air

Samuel B. McFarlane conceived two systems of rapid printing equipment.

BY SHOOTING powdered ink through the air, a newly patented electrostatic printer transfers an image to paper or a rough surface without touching it.

Samuel B. McFarlane, *Science Digest's* Inventor of the Month, believes his system is among the world's fastest methods of printing.

McFarlane has developed two forms of the equipment in the laboratories of the Sun Chemical Corporation, New York, which he serves as vice-president in charge of research and development. He recently was granted Patents 3,220,831 and 3,200,833.

In each form, an endless belt is used. In one version, the belt is made of fine metallic mesh, and in the other it is covered with closely set needles pointed outward.

A coating of light-sensitive material on the mesh or on the tips of the needles is electrically charged. A latent image of whatever is to be copied is created by exposure to light and is dusted with the powdered ink.

The transfer is made when the section of belt carrying the image passes through an electric field. The ink particles start through the air toward a plate-shaped electrode but collect on the paper or cloth interposed between.

According to McFarlane, the surface to be printed may be as corrugated as the skin of an orange. The source of the image may be film, and the printing may be continuous. Or it may be intermittent, as for office copying of original documents. If necessary, the image may be fixed with a heat lamp. No stencil is required.

Sun Chemical is considering production of the printing equipment. As to computer applications, it may license other manufacturers. McFarlane believes his method will make unnecessary any "buffer output memory" such as required for high-speed computers by a slower printing apparatus.

—Stacy V. Jones

INVENTIONS PATENTS PROCESSES

TV in the dark

THE room may be pitch dark but objects can be pictured with daylight brightness in a laser television system recently announced by Perkin-Elmer Corp., Norwalk, Conn.

Rapidly moving narrow lines of red laser light create a sharp, clear picture without studio lights or other external illumination.

The system uses a laser light transmitter and a reflected-energy receiver, contained in a single unit, instead of an image orthicon tube. Intensity of the laser beam is far below the level that would present a danger to human vision.

Because the light emitted from the laser TV camera comes from a single source, the lighting resembles a flashbulb photograph.

In the system, red light emitted by a Perkin-Elmer helium-neon gas laser is used to scan the subject through a pair of rotating, diamond-faceted mirrors. The fast line sweep of the laser beam is synchronized with the electron beam of a standard TV picture receiver. The laser light energy reflects from the subject and is sensed by a self-contained receiver. Energy returns from the subject, determining the electron beam intensity of the TV monitor's picture tube, which forms the image. A low-energy emission of about one milliwatt is enough for objects 30 feet distant.

Several potential uses for the laser

Whether light conditions are normal, as below, or darkness, the laser transmitter-receiver shown at left produces pictures of equal clarity as on the center monitor.

television system have been proposed.

It could be used as a direct vision video "radar," effective from an altitude of several hundred feet. Runways or helicopter landing spots could be marked off with reflective paints or tapes. The laser would pick these energy levels up several hundred times more strongly than it would the terrain.

Law enforcement agencies could use the system to scan dark areas such as doorways without detection.

And, according to Perkin-Elmer, a system could be tailored to secretly observe persons more than a mile away.

Tiny transmitter

An FM transmitter the size of a saccharin pill received patent 3,212,-027 recently.

The tiny transmitter, weighing half a gram without the battery, has only three components, one being a tunnel diode.

The range of the transmitter is 50 to 100 feet. Power may be supplied by a battery or by radio waves.

Inventor was Dr. Wen-Hsiung Ko, associate professor of electrical engineering at Case Institute of Technology in Cleveland, Ohio. The patent was assigned to the Research Corporation of New York.

Medical research was the first field for application. Transmitters were implanted in rats and rabbits to report their muscle signals or circulation.

The transmitters can also be attached to moving machinery to measure the forces during operations. Other industrial uses are expected.

Home-built lasers

A fully operative ruby laser, ready to be put together by a high school or college student, is now on the market.

The laser, weighing 25 pounds, comes with assembly and adjustment instructions, power capacitors, mounting stand and cables. A text on laser theory and various experiments are included in the package for $499.50 from the EOI Division of Electro-Optical Systems in Pasadena, California.

The laser is the first developed primarily for educational purposes. Accessory equipment can upgrade the original kit, said Dr. Horace R. Moore, EOI division manager.

The ruby rod gives visible radiation at a red wavelength. The company expects to provide laser output beams at varied wavelengths in both visible and invisible spectra. The laser head is a separate unit with a quick access cavity for easy rod insertion and removal.

Tire treads

One tire's tread pattern takes more than 13,000 geometric lines, angles and shapes. Draftsmen consider the drawing of the complex

mold a time-consuming bottleneck.

Now Goodyear Tire & Rubber Company has an electronic drafting machine that can do the job in minutes on a 5 x 12 foot drawing board. It took more than 18 months to program the machine for passenger or truck tire mold designs.

Pocket microscope

A microscope small enough to fit in a pocket—4 x 2 x 2½ inches—can magnify an image up to 2,000 times.

The McArthur microscope, manufactured by the Rank Organisation of London, England, weighs 18 ounces. The firm says it is unaffected by extreme temperature changes and has been dropped 500 feet without disturbing the focus.

Objective lenses are positioned beneath the specimen slide, enabling the objectives and condenser to be permanently focused. The light tube is fitted along the instrument's base. Light is reflected through two right angles from the objectives to the eyepiece.

The McArthur microscope magnifies up to 2,000 times and needs no lubrication.

The microscope can be clamped directly onto a television camera in place of the camera lens. It was used this way on a recent space flight to observe the changes in a blood specimen during space orbits. It can also be screwed directly to any 35 mm camera for photomicrography.

Satellite oven

How can the life of satellite solar cells be prolonged? Westinghouse research scientists think they may have one answer to the problem that ends the useful life of most satellites.

Communications and weather satellites and orbiting observatories are useful only as long as they have electronic voices. These are operated by solar power which is generated on board when sunlight acts upon solar cells.

But their effectiveness gradually diminishes beyond the earth's atmosphere, when high-speed particles from cosmic rays and solar flares can bombard the solar cells continuously. In a few months, the power output of the cells is cut in half.

Researchers at the Westinghouse Research Laboratories have restored solar cells to near-original performance by heating them for a few minutes to a temperature of 850°F.

Of course, in actual use this baking would have to be done while a satellite is zipping around the earth

A model of a proposed helicopter which could stop its high energy gas-operated rotor in flight and convert the triangular hub into a delta-wing for 400-mph aircraft flight.

at 18,000 miles an hour.

The researchers have suggested a system of special lenses to focus the sun's heat on the cells just as a burning glass sets wood on fire. Signals from earth would start the baking process.

In laboratory experiments, a Fresnel lens—lightweight, thin, flat, —with necessary curvatures cut into its surface—worked well.

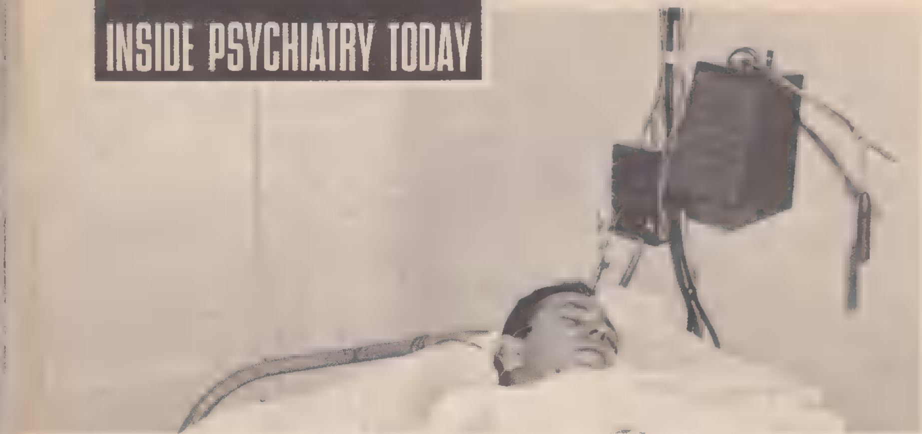
2-way copter

A two-in-one airplane and helicopter is expected off the drawing boards of Hughes Tool Company following an Army contract for a design.

The hot cycle helicopter will have a single lifting device, a helicopter rotor with a large triangular hub. After vertical takeoff and acceleration to approximately 150 miles per hour, the rotor will stop in position and the hub will serve as a wing.

Flight speed as an airplane will be an estimated 400 mph. For landing, the aircraft will slow down and the rotor started for reconversion to a helicopter.

"When the craft is operating as a helicopter, the hot cycle system utilizes a turbine engine which supplies high-energy gases through lightweight ducting to the rotor tips where it is used to drive the rotor in the same manner as a pinwheel. The rotor itself becomes the power turbine, converting the energy of the gases directly to rotary power," a Hughes engineer explained. He said that in high-speed flight, with the rotor stopped, the high-energy gas from the engines is jetted straight to the rear of the craft, providing forward thrust.



Experiment at Dream Laboratory of Brooklyn's Maimonides Hospital tests a traditional theory: that an altered state of consciousness, such as dreaming, aids psi phenomena.

What psychiatry is doing about E. S. P.

by Flora Rheta Schreiber and Melvin Herman

A YOUNG Frenchwoman named Léonie sat alone in a room waiting patiently for an experiment in telepathy to begin. Five hundred meters away, out of sight, was a group of scientists. One of them, a psychiatrist, was to hypnotize Léonie from this distance by will power alone. An observer, who had been selected by lot, gave him the signal and the experiment began. Leonie was hypnotized 16 times out of 25 tries. Not only that, but she obeyed post-hypnotic suggestions after she was awakened. One suggestion was that she go into another room and light a lamp. She did that in broad daylight, when there was no need for lights to be turned on.

The only reason you didn't read of this astounding feat in your morning newspaper is that it was carried out by Pierre Janet, a psychiatrist, in 1884. The great French physician, Jean Martin Charcot, presided, and it is almost a certainty that Sigmund Freud, who was studying in Paris under Charcot, was one of the observers. Janet, in his report of the experiment, said, "We took every plausible precaution. . . . We can conclude only óne thing: that such phenomena should be reproduced and studied."

But that is exactly what did not happen. "Janet stopped at the brink of originality and perception. . . . He hit the jackpot, but walked away without picking up his winnings,"

lamented psychiatrist Jule Eisenbud, M.D., in a review of psychiatric contributions to parapsychology.

Dr. Eisenbud said that, considering the potential of psi (psychic) phenomena in developing a comprehensive view of man's personality, it may seem strange that psychiatrists have made so few contributions to parapsychology. On the other hand, he added, "there is every reason to be suspicious of a field of study which takes seriously a group of alleged phenomena and a set of propositions which correspond closely to delusions that always have characterized the mentally ill . . . which invariably disappear as the mentally disturbed regain the capacities, the balance, and relationships with people that are generally accepted as normal conditions of mental health."

82 years later

Today, 82 years after Janet's experiment, the number of psychiatrists who are actively interested in ESP (extrasensory perception) can be counted on both hands, we were told by Dr. Montague Ullman, director of psychiatry, Maimonides Hospital, Brooklyn, N.Y., who must be counted himself on one of the ten fingers. Altogether, there are only about six full-time and about forty part-time academically trained psychical researchers in the United States, including these few psychiatrists.

A new science

Yet, this small band of investigators, cheered on by their supporters, including the 950 members of the American Society for Psychical Research, a venerable 81-year-old association, are talking of the emergence of a new science.

They are applying exacting scientific controls in their experiments, using new tools such as computers and closed circuit TV to eliminate the possibility of cues' being given surreptitiously or accidentally, and conferring with such hardheaded scientists as Dr. Henry Margenau of Yale University, a leading authority on the philosophical foundations of physics. Their object: to lay down ground rules necessary to an emerging science.

Recently, the Society sponsored its first forum on ESP. Dr. Margenau was one of the speakers. He told an audience of 200, among them scientists from over 40 universities, that science is more than a catalogue of observations. It requires a full circuit, fertile observation, leading to the cohesion and clarity brought about by taking the great leap into theory.

But he also gave ESP investigators encouragement from science itself. "Science no longer contains absolute truths," he said. "This is a day when every scientific postu-

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Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

Dr. Stanley Krippner of the Dream Lab checks recordings made of subjects' dreams.

late is held only on trial. There are changes and revisions constantly. The old distinction between the natural and supernatural is quite specious. Many phenomena not yet understood will be encompassed by scientific method in the future."

One of those attending the forum was Dr. Joost Meerloo, author of a recent book, *Hidden Communication*. "Precisely why are you, as a psychiatrist, interested in ESP?" we asked him. "As psychiatrists," he said, "we cannot use ESP as an integral daily part of the therapeutic process. To think we can is absurd. Yet, we are concerned with ESP research for two chief reasons. First, analytic therapy depends on communication, and ESP is an extension of that practice." More concretely, he added, the presence of ESP in a psychiatric patient is valuable in diagnosis. When the therapist notes ESP material, it indicates a special kind of regression, similar to the bonds between mother and child.

That ties in with statements by Jan Ehrenwald, M.D., the psychiatrist most concerned with the theoretical aspects of telepathy. He calls his theory "minus function." He believes that "a necessary condition for telepathic functioning is a state of inadequacy or deficiency such as loss or clouding of consciousness (sleep, hypnosis, trance, fever, brain defects)."

Dr. Jule Eisenbud says that the "psi process is a thoroughgoing part of the total behavior of the individual and as much of a determinant in the actions and thoughts of the patient as other types of stimuli and should be used in analysis."

A number of psychiatrists feel that they often encounter telepathic material, particularly in analysis. Dr. S. David Kahn, a New York psychiatrist who has written on the subject, said that ESP brings to the surface material that patients and analysts have repressed. To which Dr. Ullman added, "Many persons who are incapable of effective communication in normal ways can communicate at a telepathic level and surprise the therapist with a telepathic dream of rich awareness even

of the physician's problems." One of his patients, who had no knowledge that the doctor was to make a speech that kept bothering him because he could not see how to convince his audience of the validity of his esoteric material, dreamt that Dr. Ullman was on a platform addressing a large crowd in a foreign language that no one understood.

"The telepathic dreams reported by patients in analysis," said Dr. Ullman, "are at times striking and often ingeniously linked to the dynamics of the treatment situation. But the occurrence of the dream is episodic and uncontrollable. It appears under conditions in which no advance preparation is made to exclude sensory cues."

Traditional view

Agreeing with the traditional view that an altered state of consciousness, such as dreaming, in some way facilitates the psi phenomena, Dr. Ullman set up a poetically named scientific entity, a Dream Laboratory, at Maimonides Hospital.

The groundwork had already been laid. Dr. Nathaniel Kleitman, a physiologist, and Dr. William Dement, a psychiatrist, had opened the way almost ten years ago to the possibility of monitoring dreams. As previously reported in *Science Digest*, this team discovered that the sleeper has a bout of rapid eye movements measurable by electroencephalograph when he is dreaming. This meant that there was not only an objective method for the study of dreaming but also an excellent method of obtaining almost a total yield of dream recall for any night. Through this work, moreover, it was discovered that most people dream often, that many have six or more dreams a night, and that the dreams are of longer duration than previously estimated.

Dream laboratory

In the Dream Laboratory at Maimonides, the researchers test for telepathic dreams under stringent conditions. They guard against sensory cues, and three judges independently evaluate whether the target appears in the dream. The sender has no prior contact with the subject (the sleeper) during the night. A third person, the experimenter, awakens the subject and records his dream. For example, when a sender was shown Orozco's well-known painting, "Zapatistas," a scene of Mexicans on foot and on horseback with mountains in the background, the following telepathic dreams were recorded: "A storm. Rainstorm. It reminds me of traveling. I get a feeling of New Mexico when I lived there." Another was: "Shooting a picture or a stage production." Still another: "Santa Fe during the Fiesta, a great many of the Indians came in with their wares."

The next morning, the sleepers were shown the Orozco painting and others that had served as target material. They had never seen them before. They were asked to think

about their dreams as they now recalled them, then to rank the paintings in the order in which they believed they had influenced the dream. Proper ranking occurred more generally than can be attributed to mere chance.

"The present state of science," Dr. Henry Margenau told the Psychical Research Society at the conference, involves a new insight. To insist that only that which science knows and accepts today is possible is a modern attitude of dogmatism that is just as stultifying as the religious dogmatisms of the past. Science is surrounded by occult phenomena which it must accept as challenges to its competence.

Unexplained

"The conversion of a physiological stimulus into a conscious response remains scientifically unexplained today. This represents a miracle, perhaps of no lesser magnitude than the direct transmission of the contents of one consciousness to another," Margenau said.

"Materialism is dead in modern physical science. The forms of physical reality have become very strange. In the exclusion principle of quantum physics, the scientist witnesses quasi-dynamic interactions (exchange forces) which are not transmitted by physical agencies. Hence the possibility of reconciling physics with ESP is not precluded, though such compatibility has not been achieved."

Dr. Gardner Murphy, a psychologist and the society's president since 1962, enunciated the chief needs in psychical research: 1) the study of the conditions under which paranormal phenomena occur. 2) Devising special experiments that give maximum opportunity for these special conditions. 3) Development of repeatable techniques. 4) Discovery of laws or principles.

Pioneer

Dr. Murphy is a foremost pioneer among parapsychologists. Besides being president of the American Society, he also has been president of the Society in London. He now holds the chair of Research Training in Psychiatry at The Menninger Foundation, Topeka, Kansas, but served for many years as the head of the Department of Psychology at the City College, New York.

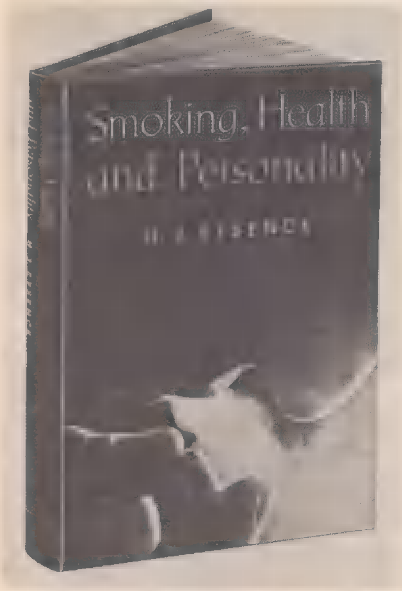
Everyone agreed that repetition of experiments in many laboratories is very necessary but noted that there are many persons gifted with ESP whose spontaneous manifestations have been quite striking. In the laboratory, their spontaneity fades. They need uninhibited ground.

But there are many things that cannot be explained by the experimental method. Dr. Merloo pointed out to us that by experiment you can't explain why the French Revolution occurred and why at that particular time.

As Dr. Murphy put it, "you can't repeat the Grand Canyon, yet you can study it."

BOOK IN THE NEWS

Smoking, health and personality



BRITISH psychologist H. J. Eysenck is really swimming against the scientific current in his book *Smoking, Health and Personality* (Basic Books, New York, $4.95). He says that the evidence linking cigarette smoking to cancer is not as persuasive as we have been led to believe. Equally good evidence, he adds, links both smoking and cancer to a specific type of personality that may be considered cancer prone.

Dr. Eysenck's criticisms of the smoking-cancer studies are not particularly new. There are shortcomings almost necessarily inherent in any statistical undertaking as massive as the these studies have been. Moreover, the research showing links between personality and smoking contain far more potential pitfalls.

In view of this, it is fair to ask if there is any good reason for a responsible scientist to publicly cast doubt on this important question. Is it, indeed, not a dangerous thing to do? Dr. Eysenck says that, because the Surgeon General's report and other similar reports have failed to stop people from smoking, he doesn't think his book will encourage a dedicated smoker to continue the habit. The smoker does not need that sort of encouragement. Dr. Eysenck, however, does not seem to realize that his book may be used as evidence to block legislation in the area of smoking.

Perhaps, though, the book has some use. That smoking directly causes lung cancer, is far from clear. And the problems involved in getting people to give up smoking or make smoking less dangerous have barely been attacked. Psychologist Eysenck suggests using conditioned reflex therapy to break the smoking habit.

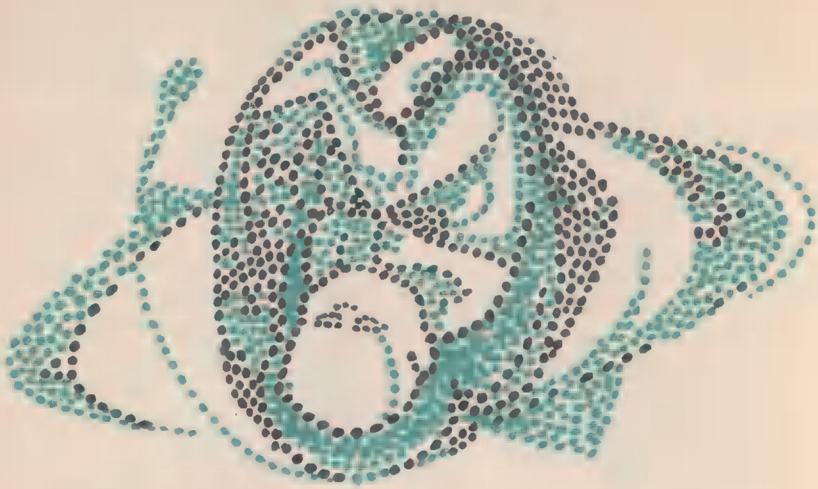
He also makes good sense on the subject of air pollution, which he regards as more dangerous than smoking.—*D. C.*

TIPS AND TRENDS

NEW HOPE FOR DIABETICS, ALCOHOLICS. Doctors at a diabetes symposium expressed optimism diabetes will be cured and prevented. A cure could come if it's true, as it now is evident, that an insulin antagonist, not an insulin deficiency, is present in diabetics. Indicated treatment: neutralize the antagonist. Prevention could come through work on the genetic code. For alcoholics, Medical World News reported, an anti-microbial drug that combats vaginal infections has been found to create a distaste for liquor, and possibly dependence on it. Follow-up studies are under way. Name: metronidazole.

TV FROM ANYWHERE. That's the promise after live mid-ocean coverage of the Gemini 6 recovery. ITT said its transportable transmitter--working this time aboard the USS Wasp via Early Bird--could bring live coverage from even the most remote areas.

BEHIND THE MILITARY SCENES. Pentagon strategists are pondering the possibility that the Soviets could upset the balance of power by technological breakthroughs. Columnist Ray Cromley cited four potential advances, among them an ability to disrupt a target country's communications just before a war. Another, an anti-missile missile, is one we've worked out ourselves. But it's expensive ($20 billion) and some say it would be provocative. In the Pentagon, the Nike-X, as it's called, is the big question. Other Soviet maybe's: a Polaris sub defense, ICBM's that pinpoint US silos.



Coming soon: World's first artificial baby

Perhaps by the end of 1966, a Soviet research team will "give birth" for the first time to a baby conceived and brought to maturity in a laboratory jar.

by Nino Lo Bello

On a quiet street in the northern outskirts of Moscow stands the Institute of Experimental Biology of the Academy of Sciences. Behind the walls lining #8 Baltiskaya Street, Russian biologists are currently undertaking what could perhaps turn out to be one of the most fantastic biological breakthroughs of this century.

By the end of 1966, if nothing goes wrong, a Soviet research team expects to be the first to "give birth" to a human being—one which has spent its full nine-month gestation period in a test tube. At this writing, the Moscow lab task force has succeeded in keeping a fetus alive outside a human womb for as long as six months. This has been accomplished by sustaining the ovum of a woman in a special glass container filled with amniotic fluid, the liquid human embryos grow in.

Today there is a curtain of silence around the test tube baby. But there has been a leak, nevertheless. The "leak" is Dr. Daniele Angelo

Petrucci, a 43-year-old research medical doctor from Italy who started the experiment several years ago.

In his laboratory in Bologna, Dr. Petrucci, a well-to-do surgeon, managed to keep one human embryo alive in a glass receptacle for 29 days before deciding to stop. A practicing Roman Catholic, Dr. Petrucci did not want to go against the teachings of his church after there were criticisms from Rome about his experiment.

Later, following some conferences at the Vatican, he took up the pioneer work once more and kept another experimental baby, whose sex he determined as female, alive for fully 59 days. This one died as a result of a mistake. Dr. Petrucci abandoned his project to give birth to a full-term baby in the laboratory, when the Vatican newspaper, *L'Osservatore Romano,* condemned the work and made the following comment:

"God surrounded the act of creation of a human being with the most supreme assistance of love, nature and conscience. It would be most monstrous to violate these conditions."

This was in the summer of 1961. In November of that year the Soviet Union invited Dr. Petrucci to Moscow to visit with biologists and talk about his experiment. Laying out the Red carpet, U.S.S.R. scientists sent him home with a medal after two months of conferences, discussions, meetings, panels, lectures and lab demonstrations at the Institute of Experimental Biology.

Dr. Petrucci went back to Bologna, aware that other scientists would now take up his controversial work without any religious or moral qualms. A year went by, but the Institute's experiments just did not quite jell the way Petrucci's had. So Moscow invited the Bologna scientist for another round of professional conferences. Once again he stayed for two months. This time the Russians did not goof.

Editor's note:
The Russian experiments described here are a continuation of work done by an Italian doctor. He undertook the experiments as a way of, among other things, overcoming apparent sterility and a high incidence of miscarriages among would-be mothers. Science Digest *describes the work, without endorsement, in order to inform its readers on an extraordinary development in biological research.*

They have now kept over 250 human fetuses alive longer than the Petrucci record of 59 days—and, according to his knowledge of the progress the Russians are making, one of these fetuses lived six months and grew to a weight of 1 pound 2 ounces before it died.

Dr. Petrucci categorically says that it is just a matter of a short time before a human being leaves his umbilical test tube and begins to grow on his own, like any other

infant. Nor will the Russian test tube baby, asserts Dr. Petrucci, be a monster or a freak in any sense of the word.

The work in Moscow is supervised by Dr. Ivan Nikolaivitch Maiscki, director of the Institute, and carried out by Dr. Pyotr Anokchine. For the latter, a brilliant septuagenarian biologist from Leningrad, the Russians are preparing a world propaganda buildup for the time when his new being—the world's first "bionaut"—joins the human race.

"Bionaut" experiment

The "bionaut" experiment began more than seven years ago when Dr. Petrucci through surgery extracted the egg from a woman who could not have become pregnant because of cancer. He united this ovum with semen taken from a man who had believed himself sterile. Conception took place in a special glass container filled with the amniotic fluid removed from a pregnant woman especially for the test.

At the outset Dr. Petrucci had more than 40 failures. All of the eggs died within a few days of conception in the glass he used as a mother's womb. Then one day he hit upon an idea. He decided to use an ovum that according to the menstrual cycle was ready for fertilization. Through chemical and biochemical tests made on a patient awaiting genital surgery, he was able to extract an ovum that was ready that very day for fertilization, a phenomenon that occurs once a month.

With a vacuum created in the small tray, or "cradle," the egg from the surgical patient was then immersed in the amniotic fluid. Through tubes, a supply of oxygen was pumped in, creating a perfect natural environment for uniting the male sperm with the female ovum.

This time Dr. Petrucci's egg did not die after a few days. When the nucleus of the germ cell began to divide, subdivide and enlarge, Dr. Petrucci knew he was at last on the right track. As the fetus took the shape of a baby in its early stages and started to develop "legs" on the 29th day, Dr. Petrucci killed it because of the criticism being leveled at him. One Italian newspaper, having dubbed Petrucci's fetus "The Thing," claimed he was creating a Frankenstein monster.

Eye formation

Later, after the hullabaloo died down, the Bologna doctor quietly repeated the incredible trials and kept a "child" alive for 59 days. Its ears, eyes, arms and spine were clearly visible. Also there were the noticeable traces of a mouth, neck, reproductive organs, heart and umbilical cord. By the seventh week, Dr. Petrucci could distinguish the eye formation of the embryo. With the help of laboratory instruments he was able to register the activity of the "baby's" heart. He even traced and filmed the blood circula-

Human life in the laboratory

The ovum is separated from the follicle in Dr. Daniele Petrucci's laboratory.

Dr. Petrucci's "test tube" apparatus acts as the "womb" for the developing fetus.

This is Moscow institute where artificial baby experiments are now being conducted.

Dr. Petrucci works in Bologna laboratory where "test tube" baby experiment began.

tion of the developing embryo.

On the 59th day, however, the heartbeat failed and the embryo died. Dr. Petrucci believes it died because the special nutritional transfusion plasma he had been feeding it was no longer suitable. The Russians have now taken over at the point where Dr. Petrucci quit his experiments.

Specialist in tissues

The bearded Italian scientist, a specialist in tissues, maintains that he was not necessarily interested in creating human life outside of a human womb just for its own sake. Specifically his purpose with the experiment was to grow human tissues and glands that would not only be transplantable but acceptable by the body of an adult in need of such.

"We thought the chances of a glandular transplant's surviving would be improved if we obtained a gland from an embryo that was first cultivated outside a human body in plasma and then irrigated with plasma belonging to the new host. For these reasons we started out researches at the stage of fecundation *in vitro* and cultivation of the zygotes until the organs in which we were interested could be extracted from the test tube," Dr. Petrucci wrote in a scientific paper for a medical journal.

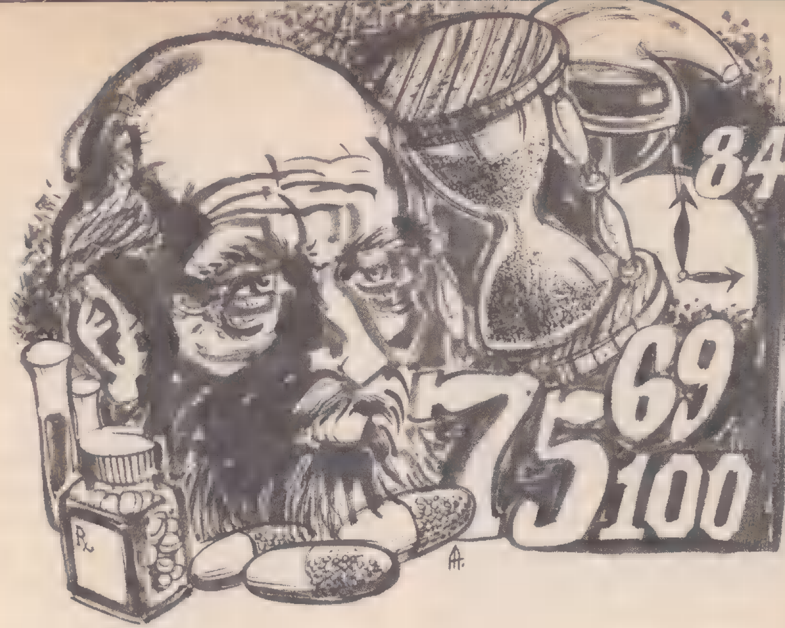
Dr. Petrucci claims that his tests also have begun to show how to save the lives of countless unborn children. Convinced that observation of the living cell in a test tube has demonstrated some of the causes of miscarriage, he feels that one benefit of his experiment is that it may lead doctors to find ways to prevent miscarriages.

"One of my aims is to help women have babies, for I have been upset by the large number of women giving birth to stillborn children, especially at their first pregnancy," explains Dr. Petrucci, himself the father of two young children. "Thus my research was directed along humanitarian lines, guided by the Christian principles I have practiced since childhood. I love mankind. If a wife should lose a baby on which the hopes of herself and her husband have been centering, this is a human tragedy. That I should be denounced for my experiment is a great personal blow, for I am a scientist dedicated to uncovering those mysteries of nature that God is prepared to reveal to us."

Late 1966

Now that the Russians have taken over his work, Dr. Petrucci is sure they will succeed in creating a full-term human being in a test tube. According to his calculations, the first baby will be "born" no later than Christmas, 1966.

"But," he adds, "we are having a population explosion today. So really there is no need to produce babies in a test tube. Besides, children should be raised by parents—not by scientists."



How we can delay old age

by Andrew Hamilton

THE AVERAGE man or woman in the United States can expect to live to about 70 years of age—the well-known Biblical three score and ten. When an individual reaches his 100th birthday, it's an occasion for newspaper interviews and headlines.

Some scientists believe that control of cancer, arteriosclerosis and other diseases could push man's natural life expectancy to about 80 years. Beyond that, however, there would have to be some alteration or slowing down of the fundamental processes that cause aging.

Studies of the process of aging are being carried on at a dozen major centers in the United States—such as the National Institutes of Health, Harvard, Chicago, Johns Hopkins, Yale, UCLA and Western Reserve.

One of the scientists who has done considerable work in this field is Dr. Harry Sobel, Chief of Aging Research at the Veterans Administration Hospital in Sepulveda, California, and associate professor-in-residence of the School of Public Health at UCLA.

The problem of studying the aging process in human beings is a formidable one, he points out. Just how do you go about such research? Animals can be placed in an ideal environment and subjected to controlled studies all their lives.

A hardening gelatin in connective tissues may be one culprit.

This is not possible with man.

Biochemists have developed two principal approaches to the difficult problems of human aging:

1. To discover what happens *inside* the body cells that may result in aging.

2. To determine whether aging is the result of events *outside* the cells—in the connective tissue that surrounds them.

"Both lines of attack," explains Dr. Sobel, "are complicated by an overall problem. Are cellular changes due simply to the passage of time—or are they the result of past events in an individual organism's life that activate irreversible aging processes?"

Multiple influences

Because human beings are subject to many environmental influences, any or all of them could be responsible in part for aging. We live under the constant pull of gravity. We breathe an atmosphere in various climates and temperatures. We are constantly bombarded with various amounts of radiation. Are these factors crucial in the aging process—or do we age independently of them?

"Nobody can answer such questions with certainty now," Dr. Sobel says. "But there is a great deal of evidence of what goes on both inside and outside the cells that may contribute to aging."

One current theory is that aging may be due to changes that take place in genetic material in the cell. This theory holds that with the passage of time DNA molecules lose their ability to transmit "information." This function is so essential that without it other molecules cannot do their work properly or even exist.

Another theory is that inert particles accumulate in the cells and have no way of getting out. For example, there is evidence that a pigment called lipofuscin accumulates in many tissues with age. There is some doubt about where this substance comes from, but there is no doubt that cell mechanisms have difficulty getting rid of it.

As Dr. Sobel puts it, "It accumulates and gums up the works. And it may interfere with other portions of the cell doing their work."

Still another theory suggests that radiation received by the body may account for aging. According to this explanation, cells need not be directly hit by rays. Indirect damage may be done to the nucleus of the cell.

"We are paying particular attention to what happens to molecules with age," Dr. Sobel says. "A number of investigators have noted that large molecules become more immobilized and hooked together. When

this happens, they become less mobile metabolically. Also, with age there may be an impairment in the flow of molecules through the connective tissue."

For some time scientists have been puzzled by a curious fact. It is this: When a young man is compared to an old man, there is an obvious physical difference in external appearance. But when their individual body elements are broken down into finer and finer constituents, the differences that are obvious externally are not so obvious internally.

Enzyme levels

For example, the enzyme levels of young and old persons are about the same. Even a 10 percent difference may be great indeed. This conclusion may also hold true for other elements in the body.

Dr. Sobel's own research has been to learn what happens to connective tissue surrounding the cells. He has discovered as many as 10 changes that take place in the immediate environment of the cells. These alterations, he believes, may account in part for the aging process.

"I don't mean to imply that what happens inside the cells is not important," says Dr. Sobel. "It is. But we have to consider both inside and outside influences."

Dr. Sobel has discovered some particularly interesting facts about the substance collagen which is soluble and becomes gelatin when cooked in hot water. At body temperature, however, it is relatively insoluble. And, with the passage of time it becomes more and more insoluble. Finally, it just lies relatively dormant in the connective tissues.

Dr. Sobel believes that collagen accumulation may in part account for the eventual reduction of cellular efficiency. Collagen is an important substance because it comprises one-third of all the proteins in the body. There is much evidence that with advancing age this substance is found in greater amounts in the blood vessel tissues. This may account for increasing difficulty—with advancing age—for cells to obtain nourishment.

"By its very nature life begets death," Dr. Sobel points out. "For life to flourish, there has to be interaction with its environment. Substances have to flow to and from cells for their nourishment. There is a penalty for this nourishment—one of which is the accumulation of collagen. There may be other residues that interfere with cellular efficiency. The accumulation of collagen and the changes which take place in its structure may be studied in a simple skin test. This may give doctors a way to measure an individual's physiological age."

Dr. Sobel believes the so-called "diseases of aging"—hardening of the arteries, cancer, kidney trouble —may contribute to the aging process, but are not the direct cause. For example, it has been

demonstrated in the laboratory that if atherosclerosis is imposed on a young animal, the effects are far less disastrous than on an older one. The former is better able to tolerate the deterioration.

Irreversible changes

This brings up the "past events" theory of aging. Many of the events in a person's life may leave irreversible changes. For example, the diseases he has incurred, his diet throughout life, the amount of radiation to which he has been exposed—all these and a host of other factors may combine to subtract time from the life span. Again, Dr. Sobel poses the riddle of collagen: "Does a person live to a ripe old age because he accumulates less of it, or was he born with an innate ability for a lower level of accumulation?"

Research on aging has apparently come up with an answer to the question of why skin wrinkles. Wrinkling was once thought to be caused by changes in a material in the connective tissues called elastin. It is now believed that wrinkling is caused by the loss of hyaluronic acid which has an ability to hold water. Connective fibers of the skin move closer together, thus reducing the turgidity of the skin.

One long-held theory of aging is that hormones play a major role in the process. Dr. Sobel believes they do play a role, but not a key one. They appear to act as "modifiers." It may be that with age hormones cannot reach the cells at a fast enough rate because of the residues that block them.

Dr. Sobel has studied some of the factors that control the highly-important protein molecules in tissues. When an organ is growing, there is an increase in the individual proteins in its cells. During later life if an organ—such as the heart—needs to work harder, its cells will get bigger rather than multiply. This is basically what happens when we exercise our muscles. Proteins are made to grow larger to do the job. On the other hand, if an organ is left inactive, deterioration may become irreversible.

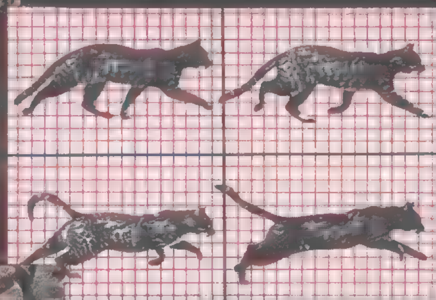
Dr. Sobel likes to speculate that under other environmental conditions—perhaps when man travels to other planets—there may be surprises in store. Changes in atmosphere, gravity, temperature and radiation might affect his longevity.

Meanwhile, back here on earth, scientists continue to search for secrets that control the rate of aging.

"I'm optimistic," Dr. Sobel says. "Some day—in the not too distant future—we'll find them."

FROM THE MYSTERIOUS GEOMETRY OF NATURE . . .

The double spiraling of the daisy head bears a curious relationship with a mathematical sequence known as the Fibonacci series. It is produced by starting with 1 and adding the last two numbers to arrive at the next: 1, 1, 2, 3, 5, 8, 13, 21, 34, etc. The daisy head has 21 clockwise spirals, 34 counterclockwise.

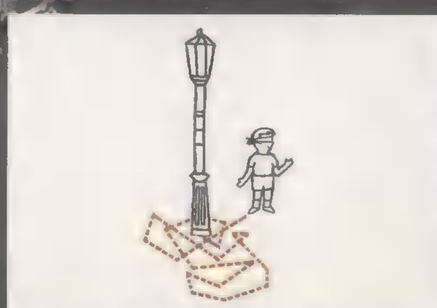


. . . TO THE CALCULUS IN A STARTLED CAT . . .

Just as a movie film consists of repeated still pictures of a moving object, so does Calculus break motion down into an infinite number of "instants." Thus mathematicians can calculate an object's speed and acceleration at a specific instant.

. . . TO THE AMAZING COINCIDENCE OF BIRTHDAYS . . .

Out of any 30 people in a crowd, the odds are better than two to one that at least two of them have birthdays on the same date. Above 50 people, the chance approaches certainty. Try it on 50 friends!



. . . TO THE "RANDOM WALK" PRINCIPLE OF MODERN PHYSICS

If a blindfolded boy walks away from a lamppost, changing direction now and then according to whim, the "law of disorder" predicts that he will keep returning to the lamppost. Young Einstein used this principle to describe the movement of tiny particles suspended in a liquid.

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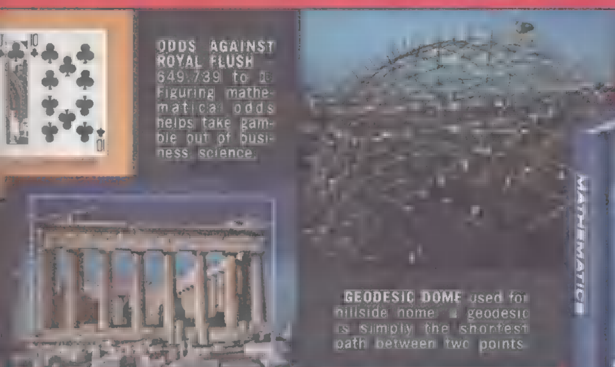

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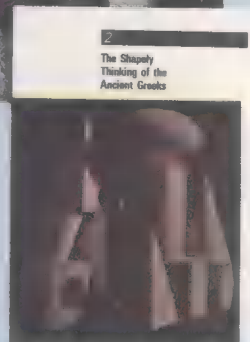

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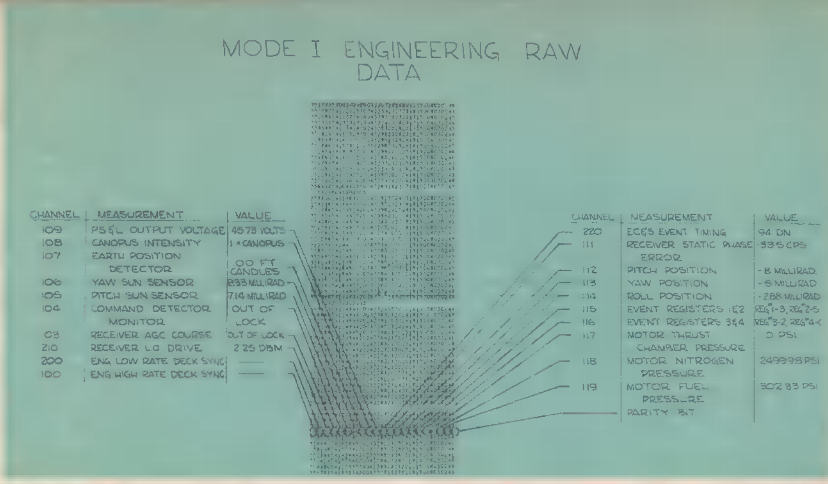


Ampex

Six trillion words have been garnered on thousands of miles of tape in columns of figures like these to provide

Messages from space

by Jeanne Reinert

A SMALL rocket nosed into the atmosphere above Auburn, Mass., exactly 100 feet. An on-board camera snapped a picture of the rocket's barometer and thermometer and the craft floated back to earth with the first recorded instrumentation data from a pilotless flight. The year: 1929. The scientist: Dr. Robert Goddard.

A space vehicle jettisoned its rocket carrier and continued 325.1 million miles to Mars. After a seven-month journey with a margin of error of less than three ten-thousandths of one percent, it sent back 21 photographs on command. The year: 1965. The scientists: a U.S. space team of hundreds.

That leap in space-tracking technology reflects an almost unbelievable proliferation of communication techniques in recent years. The technology has developed so rapidly that the Deep Space Network is expected to transmit one billion times more information this year than it could in 1960.

Two items, digital computers and magnetic instrumentation tape recorders, brought about the giant change in the data obtainable from spacecraft as they ferret out the secrets of the solar system. But how do these machines combine their talents to acquire so much information?

Basically, three types of information are needed—engineering, scientific and command.

Engineering data is a satellite's housekeeping record. It includes the pitch, yaw, skin temperature and instrument function of the vehicle in space.

Scientific data is the object of a mission. It includes information on such matters as an astronaut's blood pressure, levels of radiation or the topography of the moon.

Command data is the orders issued to a craft. Typical instructions are: Turn on the camera, Change direction or Return to Earth.

At present, the only feasible way to transmit signals over interplanetary distances is via radio telemetry. Telemetry means literally, "to measure at a distance."

Two instrumentation tape recorders caught and recorded the Mars photos.
Ampex

Computers were installed in data-receiving centers in the early 50's. Oscilloscopes, which had been the backbone of telemetry for 20 years, began to show limitations. Signal data had to be read and reduced to useable material manually. Data could be fed into computers at about only three characters per minute.

Soaring range

With the first use of tape recorders in 1950, frequency range soared from 5,000 cycles per second (on an oscilloscope) to 100,000 cycles per second. You can compare that to high fidelity music, which is recorded at 15,000 cycles per second. Currently, two million cycles are possible with a conventionally designed recorder. New rotary-head recorders will put five million cycles per second on tape. In effect, these extra frequencies provide extra room for data.

A high-precision magnetic tape recorder can commit 1,300 individual measurements to an inch-wide segment of 14-track tape in one second. By using a sampling method, 100 separate types of information can be put on a single track. The information may be fuel consumption of the craft or the strength of solar winds.

Who is likely to request "space" on a tape during a space probe? Well, medical specialists and engineers. Take Dr. Jones, an expert on muscles. NASA circulates information about a proposed manned

flight to scientists. Dr. Jones may respond. He may want to place a sensing device on an astronaut's right biceps to measure the strain the arm undergoes to remove the hatch from the spacecraft after 48 hours in space. If NASA wants the information, Dr. Jones will probably design the instrumentation.

In the week preceding the space shot, beginning with the final equipment check to the moment before blast-off, an average of 1.7 billion words are recorded. This complete record may be referred to later, especially if something goes wrong.

Blastoff data

At blast-off, a great burst of data is recorded. In 20 minutes, an equivalent of 115 million words are put on tape. The Library of Congress estimates 30 digital "bits" compare with one word in English.

Data originates from sensing devices—thermometers, areas sensitive to pressure, radiation and altitude—attached to control panels and craft structures. Dr. Jones's instrument is attached to an astronaut's biceps. Sometimes this data is relayed directly to Earth and sometimes it is stored in an onboard tape recorder until a more convenient transmission time.

All the data is beamed across space as radio signals. On Earth, these signals are caught in big dish antennae located at stations around the globe in such places as Alaska, Australia, South Africa and Ecuador. As the spacecraft passes overhead, earth-bound magnetic instrumentation tape recorders attached to the antennae inscribe the signals "bit" by "bit" on tape. These signals are converted from analog, an electrical analogy of the original phenomenon, to digital code, the language of computers. In digital form, they can be analyzed electronically.

Tape recorders, especially those on board, carry a big advantage in that the signals can be played back immediately and at speeds faster or slower than the original recordings. Speed can be matched to the rate of data coming in—at present those speeds range from one and ⅞th inch per second to 120 inches per second.

However, scientists must know exactly when an event happened, especially when data is sampled. The pulse representing a vibration may be picked up a millionth of a second ahead of the pulse representing a temperature change. It is critical that the separation be known exactly. This is called time base stability and the more accurate it is, the more data can be dependably recorded.

What information can space probes return to Earth?

So far they have given us news of a radiation belt up to heights of 40,000 miles, revealed the existence of a constantly blowing solar wind, told us about a broad layer of helium stretching far above the previously known atmosphere and about a rain of cosmic dust that

40,000 dots can store one photograph on tape.

dumps about 10,000 tons on Earth each day.

Photographs are taken with a television camera. A light-sensitive metal, selenium, transforms the varying amounts of light coming in the camera into varying amounts of electrical charge. An electron beam races back and forth across the selenium, reading off the charges, much as an electron beam scans for television.

For the moon photos, these electron beam signals were relayed directly to Earth for reconversion into a picture.

Stored on tape

For the Mars photos, the data was stored on tape, each picture encoded in 200 lines of 200 dots each. This compares with 525 lines used on commercial TV screens.

The light intensity of each dot was recorded in a numerical code that allowed 64 shadings from white to deepest black. Pictures were recorded at 10,700 digits per second. They were transmitted back to earth at 8.33 "bits" per second so the message could not become garbled as it travelled through the 144 million miles of space.

After the flights, tape from all tracking stations are collected in a central laboratory and copies of each original tape are made for Dr. Jones and others who will be reducing and analyzing data.

At first, Dr. Jones will look over the data. He will know which subchannel bears his muscle-signal impulses and which signals represent the time base. The latter will identify on the tape the exact times when the astronaut performed known tasks.

In the laboratory

Dr. Jones can play the tape on his laboratory tape recorder, which is hooked up to an oscilloscope or other visual readout device. As the recorder plays, signals become visible patterns on the oscilloscope screen. Zigzags in the oscilloscope pattern reflect the occasions when the muscle was working. Only significant changes in the pattern matter to Dr. Jones. He may play the data back at 75 inches per second, even though it was recorded at, perhaps, 7½ inches per second. That's about the speed of "fast forward" on a home tape recorder. Thus, Dr. Jones identifies the portions of the tape he wants to computer-process among the miles and miles of tape.

In computer-processing, Dr. Jones knows how the biceps works on Earth and what he expects of it in space flight. He can program his computer to compare the space data with his expectations. Hopefully,

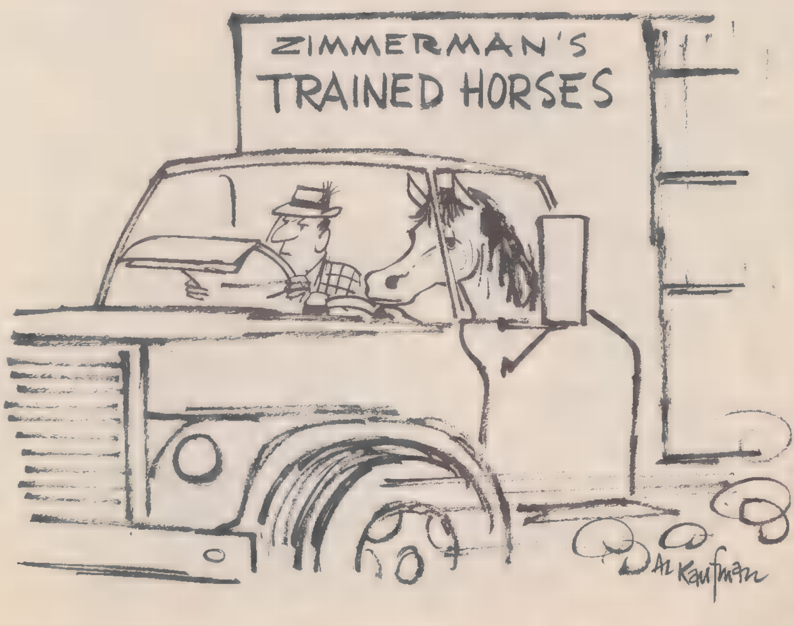
the computer can tell him how the biceps sized up in space performance. Runs are repeated until all of the information is extracted from the space tape. It may be weeks, months or even years from the time Dr. Jones first saw the raw data on his oscilloscope to a complete report of useful knowledge gleaned from the biceps signals.

Scientists may find useful new information on tapes made on flights years ago. A new discovery can cause the reinterpretation of old data. Hundreds of thousands of miles of tape, each containing millions of different units of data as permanent electrical impulses, are the significant legacy of more than 300 U.S. space shots.

It is estimated that NASA's archives of tape recordings from all U.S. space shots contain more than six trillion words in data documenting the shots. If you wonder how to gauge that, it was estimated in 1963 that approximately four trillion words were contained in all of the works in the Library of Congress.

325,000 miles

Mathematically, American's total space program has generated approximately 325,000 miles of data-bearing magnetic tape. That's enough to reach from the moon to the earth with enough left over to wrap around the earth three times and then tie a large bow.



Are chimps really animals?

by Daniel Cohen

WHAT differentiates man from his primate ancestors, according to scientists, is that man can make and use tools. Now, as a result of the careful observations of a young Englishwoman, the great anthropologist, Dr. Louis S. B. Leakey, has said, "We must either redefine man—redefine tools—or accept chimpanzees as men."

The young woman is Jane Goodall, who at the age of 26 and without any special training, began what Dr. Leakey has called "the most remarkable study on any primate ever made."

It's not just that her discoveries will help us understand the behavior of chimpanzees better, and our own behavior as well. Jane's five-year expedition also contains all the elements of a roaring good story: frustration and triumph, heartbreak and humor, danger, high adventure and that rarest of all elements—genuine romance.

In July, 1960, Jane Goodall, with Dr. Leakey's encouragement, began her lonely task of observing the daily lives of the chimpanzees in Tanzania's rugged Gombe Stream

photo © National Geographic Society
Jane Goodall was the first scientist able to get really close to wild chimpanzees.

© N.G.S.

Adult male chimps are stronger than a man and can be a dangerous enemy, but Jane's patience has converted them to friends.

© N.G.S.

Limited trust is shown by mother chimp as she allows her baby to touch Jane while still holding him with a restraining arm.

Reserve. Chimpanzees, those animals considered closest to man, had often been studied in zoos, but because in the jungle they are extremely wary of man, powerful and potentially dangerous, their life in the wild was practically unknown.

Winning the confidence of the chimps so that she could get close enough to observe them took enormous patience. Dr. Leakey uses Jane's success as sort of an inspirational story for other scientists. He told a meeting of the world's leading anthropologists, "You must have a dedication and a willingness to go all out through illness and bad climates, always with the knowledge that despite your dedication, you may not get the answers at all. On this matter of devotion, let me remind you that Jane Goodall is now in her fifth year of studying the chimpanzees, and in the first eighteen months she got none of the important results she has obtained since."

What are the important results? Says Jane, "The fact that these chimps use twigs and grasses when feeding on termites was one of the most exciting discoveries I made. It was known that some wild animals use natural objects as tools—but the chimpanzee, when he strips leaves from the twig, is actually modifying a natural object to suit it to a specific purpose . . . and he is thus making a tool."

Chimps also crumple leaves to make "drinking sponges." These home-made "sponges" are dipped into water and the water that clings to them is sucked off by the chimp. The crumpling of the leaf, Jane notes, increases the absorption. It is another example of how these highly intelligent primates are able to adapt natural objects to a specific purpose, another example of tool-making. They also use leaves as napkins to wipe sticky food off their hands and mud off their feet.

Another important discovery she made is that chimpanzees regularly catch and eat other animals, usually

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Chimpanzees often come to Jane's camp for food. Bananas are their favorite treat and some can eat 50 at one sitting.

Below: Mutual grooming is a favorite social activity for chimps. Occasionally Jane is allowed to participate in this activity.
© N.G.S.

small monkeys, but sometimes animals as large as young deer.

Jane Goodall's observations have a direct bearing on a school of thought that has been developing in recent years among students of man's evolution. Evidence has accumulated that man rose from a line of carnivorous apes, and that he first used altered objects as weapons not tools. In addition, some studies of primate behavior seemed to indicate that many of the higher primates were unusually aggressive even vicious types of animals. Thus, the thinking ran, man may be "a natural killer" and this killer heredity may explain mankinds seemingly irrational attachment to wars and other forms of violence.

Jane's discovery that chimps are occasional hunters seemed to support the natural killer theory. But writing in *National Geographic* magazine, she says, "In some scientific circles a controversy turns on the question of whether early man first used objects as tools or as weap-

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Jane Goodall watches at close range as chimpanzee mother plays with her baby, whom she has placed in a metal basin.

© N.G.S.

Right: Almost hidden amid the dense jungle foliage are Jane and her photographer husband, The Baron Hugo van Lawick.

© N.G.S.

Left: Chimps have a wide variety of expressions. Here one curls his lips, exposing a row of sharp, wicked-looking teeth.

ons. One certainly, cannot draw concrete conclusions from this chimpanzee community. But the examples I have given amply demonstrate that these chimps, though seldom using objects as weapons, have reached a high level of development in selecting and manipulating objects for use as tools."

In general, observations at the Gombe Stream Reserve indicate that wild chimpanzees are very much as we would like to think they are—intelligent, individualistic, cooperative, affectionate and, even as adults, playful.

There is, of course, a definite social hierarchy among the chimps, but it is not a brutal oppressive one. Real fighting among chimps is rare, even during the mating season. Jane describes a classic meeting between two giant male chimps, "Catching

sight of each other, the two friends ran together and stood upright face to face, all their hair on end. They looked magnificent as they swaggered slightly from foot to foot before flinging their arms around each other with small screams of pleasure and excitement." Aggression is worked off in ferocious but harmless displays, rather than real combat. The chimps have even worked out a fairly tolerable state of peaceful coexistance with their nearest relatives and competitors, the baboons.

A dangerous place

Jane Goodall initially intended to start her study accompanied only by an African cook and his family. Tanzania authorities, however, insisted that she bring along someone else because the jungle was a dangerous place for such a young girl. So she brought her mother. The authorities soon became convinced of her competence and seriousness and her mother returned to England. Home during the difficult early months of the study was a simple tent, and at that time the question of whether or not finances for a lengthy study would be available was even in doubt. After three preliminary months, the National Geographic Society took over sponsorship of the research and financed it for another 20 months. Those 20 months stretched out to five years. In 1965, work had been completed on three semipermanent buildings in the area, where research will continue on a long-term basis. Jane feels that at least 10 more years of observation are necessary to trace the complete life history of the chimps at the Gombe Stream.

Help came from other sources. Enda Koning, a Dutch girl living in Peru, had been so inspired by Jane's first article in *National Geographic* that she scraped together her own fare to Africa so she could be part of the project. Later, they were joined by Sonia Ivy, an assistant secretary, to help with the monumental amount of paperwork.

How about the romance? In 1962, Dr. Leakey suggested to the Dutch noblemen and noted wild-animal photographer, Baron Hugo van Lawick, that he should film Jane Goodall's chimpanzee friends. The Baron's photographs are not only some of the most remarkable wild-animal pictures ever taken, they also form an invaluable part of the scientific record. His color motion pictures were the basis of a CBS-TV special on Jane Goodall's work shown late in December.

The Dutch nobleman and the English scientist were married on March 28, 1964, in London, where Jane, a candidate for a Ph.D at Cambridge University, had gone to finish a term. They limited their honeymoon to three days. They rushed back to Africa because they had received word that one of the chimps that they had been observing for a long time had just had a baby. Romance or no, they wanted to chart the development of an infant chimp in the wild from the very beginning.

An outside electric heart pumped blood around this dog's intact heart, keeping him alive for two days.

Spare hearts are already here

by Bruce H. Frisch

A 42-year-old man lay on the operating table, his chest open, his blood shunted through a heart-lung machine, while surgeons replaced a damaged heart value. The artificial valve in place, the surgeons transferred blood circulation back to the man's own heart and lungs. The heart was too weak; it stopped. Massage brought it back, but it limped. It needed help. A small plastic pump was brought out, and sewn between the heart and the main artery, the aorta. As the plastic pump picked up part of the load, the patient's blood pressure and pulse settled back to normal.

A preview of the future? No, a reenactment of the past. The place was the Baylor University College of Medicine. The year, 1963. The pump was an experimental one used in dogs. Four days after the operation the patient died, but not from his plastic heart.

The artificial heart is not coming, it is here.

Human hearts have four chambers, but artifical hearts need only two.

A partial artificial heart specifically for humans may go into use this year. A complete heart will arrive in three to five years, predicts Dr. C. William Hall, assistant professor of surgery at Baylor.

"There will be a mechanical heart in a patient before there is a man on the moon," claims Dr. Adrian Kantrowitz, chief of surgery at Maimonides Hospital in Brooklyn.

Deluxe model

The National Institutes of Health has set itself the same goal as the man on the moon program, 1970, for perfecting a deluxe model artificial heart. It is adopting the sophisticated systems approach of the space program for designing its heart package as an integrated whole. Last year the first study contracts were let in a program that may ultimately cost $100 million.

The old-fashioned way of individuals banging away piece-meal in their widely scattered labs has worked fine until now. In only nine years the main problems have been reduced to three—how to reduce damage to the blood, how to stop clotting and how to power the artificial heart without running wires or tubes through the chest.

The original impulse was to adapt the kinds of pumps used in machinery—piston pumps, centrifugal pumps, diaphragm pumps. These failed, and since then the artificial heart has become more and more a replica of the real heart.

The real heart is actually two, a left one and a right one. The right one drains blood from the body and pumps it through the lungs. The left heart receives blood from the lungs and pumps it through the body.

In structure the heart is a sac of muscle with a wall down the middle dividing it into two large chambers called ventricles. Each ventricle has an inlet and an outlet valve. On the upstream side of each inlet valve is an antechamber to the ventricle, called the atrium, with its own inlet valve. Blood flows through the atrium into the ventricle during filling. In the last stages of filling the atrium contracts to complete the process. Then the ventrical muscles contract, forcing blood out into the arteries, and relax into a limp bag to be ballooned out with a new supply of blood.

Experimenters with artificial hearts have found the atria unnecessary. Artificial models are two-chambered, four-valved hearts.

Failures in early experiments on dogs came in many forms. Sometimes the hearts simply wore out from material fatigue. A heart that beats 70 times a minute, beats 41 million times a year. Even today we have no proof that any present

artificial heart can work a long time in a body, because experimental animals die in about two days.

Sometimes the right heart pumped more blood than the left heart. Pressure built up in the vessels of the lungs, forcing fluid through the walls into the air sacs. The animals drowned.

Pooling problems

Almost always, though, autopsy revealed a pooling of blood in the abdominal organs. A couple of engineers found out why. Spyridon Moulopoulos and Stephen Topaz at the Cleveland Clinic wired up an electric circuit that behaved like the circulation system. After simulating heart experiments electrically they concluded that the high peak pressures delivered by pumps then in use triggered blood vessels of the skeletal muscles to close down. Blood shut off from the muscles had nowhere to go but to the abdominal organs. To cure pooling, often very elaborate controls were designed to shape the pressure curves of artificial heart pumps so they were more "physiological." The machine heart was giving way to the replica heart.

The resemblance grew closer with the sac heart, a rubber bag modelled after the heart's muscle sac. Around its mouth the bag is attached to a rigid housing. Compressed air led into the gap between the bag and the housing squeezes blood out as the muscles do in a living heart. The action is gentle, while previous pumps had been rough.

Floating in the blood are the red

A booster, developed at Maimonides Hosp., Brooklyn, pumps as the real heart fills.

All-internal replacement heart from Indiana U. would have abdominal power pack.

cells, fragile bags of hemoglobin. Artificial hearts break the bags of many and damage others that burst later before their normal average life of 120 days. Hemoglobin was being spilled faster than the marrow, spleen and liver could scavenge it. At the end of 24 hours the amount of free hemoglobin in the blood of experimental dogs climbed to 20 or 30 times normal. The gentler action of the sac heart has reduced the rate of destruction to where scavenging can keep up. But even the latest hearts destroy red cells faster than they can be replaced by marrow. Over a long period with an artificial heart, a patient not fortified with new blood would sink into anemia.

Clotting

The sac also helped in the fight against the most serious obstacle of all, clotting. After an experimental animal has been saved from all other possible deaths, it eventually succumbs to a peppering of clots clogging the vessels of its kidneys, lungs, liver and brain. Clotting begins when blood cells called platelets touch wettable or rough surfaces and burst, releasing a trigger chemical. The best antidotes have been clean design and the right materials.

Clean design means smooth surfaces, smooth flow and no pockets in which blood can stagnate. The smooth contours and smooth surface finish of the sac have almost eliminated clotting there, but the valves remain a serious problem still to be overcome.

The leaflets of plastic used in early attempts to emulate living valves made of flaps of skin failed from fatigue. Researchers turned mainly to ball valves as the next best thing. While mechanically dependable, they caused clots and damaged the blood. Now a promising new kind of leaflet valve has been developed by Drs. Harris Shumacker, Jr. and W. Burns of the Indiana U. Medical Center. The valves look like short pieces of flabby tubing. They are attached to the housing at one end. Blood flowing one way opens the valve to its full diameter. Blood flowing in the opposite direction collapses the tube in on itself, making the end look like the mouth of someone who has sucked in his cheeks. (See "New Hope for Ailing Hearts," Jan. '66).

Silicone rubber

The best material at present is Silastic, a silicone rubber. Among metals, platinum and stainless steel resist corrosion, but become covered with clots. Aluminum and magnesium quickly corrode, but tubes of them stay unplugged for a year. Alloying may prevent corrosion of aluminum and magnesium. A new coating worked out by Dr. Vincent Gott at the U. of Wisconsin Medical School may shield many materials that form clots. The coating's principal active ingredient is heparin, a natural anticlotting agent that is quite possibly concentrated in

Energy to power a heart could be beamed, like radio, into the body.

the walls of normal blood vessels.

The third big problem in artificial hearts is how to supply the power. Early workers used electric motors fed by wires running through the chest wall. The excessive heat given off by a motor made most switch to compressed air sent in through tubing. Now, piezoelectric crystals developed at the U. of Pennsylvania School of Medicine seem to have beaten the heat. Two strips of piezoelectric crystal cemented back to back bend when a voltage is applied to them. Under an alternating voltage the end of the two-layered strip wags back and forth (or a disc dishes one way, then the other) and could alternately compress the two sacs of a heart. Since the efficiency of conversion from electrical to mechanical energy is almost 100 percent, there is little heat waste.

Alternative muscles

Intriguing attempts have been made to harness diaphragm, back and thigh muscles to squeeze an artificial sac heart. Implanted pacers electrically stimulated the muscles in a rhythmic beat. At least in the case of the thigh muscle the unaccustomed constant labor damaged the muscle.

At Tufts-New England Medical Center a team has placed the sac just under the skin and run plastic tubing from it to the aorta. An air-driven bulb on the skin *outside* the body presses on the sac to force out the blood.

Fuel cells

A couple of completely internal power plants in the talking stage are the fuel cell that would generate electricity by chemical reaction with body fluids and a miniature steam engine fueled with radioactive isotopes.

The best bet today seems to be to broadcast energy to the artificial heart. A radio station radiates electromagnetic energy from its transmitting tower. These waves induce a current in your receiving antenna.

As partially worked out at the U. of Missouri School of Medicine, a coil of wire outside the body would induce current in a coil inside the body. During the day a patient would wear a battery-powered pack weighing about one pound for each hour he would be on his own. At night coils around his bed operating off house current would take over.

In the package being worked out at the Indiana U. Medical Center, the induced electric power would drive a motor turning an hydraulic pump piped to the heart. At present the motor and pump are made to fit in the abdomen. Eventually Indiana workers hope to make all parts worn internally small enough to fit

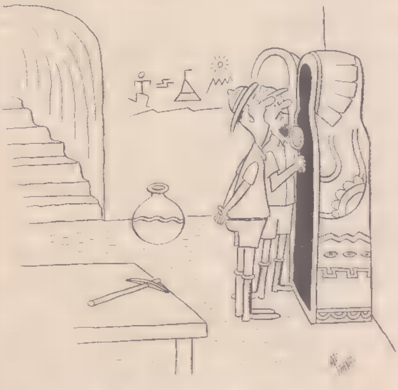
in one unit $1\frac{1}{4}$ times the size of a normal heart.

Every approach will be studied by industrial contractors working with NIH to make the definitive heart by 1970. Perhaps they will find that a complete artificial heart is unneeded. Perhaps the millions will go into an assistant heart.

Assistant heart

One assistant heart developed at Maimonides Hospital has run 41 continuous hours in a dog. It is a piece of flexible Silastic tube that looks like a swollen section of artery and is spliced into the aorta. Around it is a housing, and that's all. There are no valves to cause clots.

After the intact, real heart beats, air piped into the housing squeezes the inside flexible tube, forcing blood out in both directions. Blood that goes back toward the heart closes the heart's own outlet valve.



"The years have been kind to him."

Most of the blood goes to the body.

The assistant heart takes over 60 to 80 percent of the work. Often the relieved heart would be able to repair much of the damage that got it in trouble. If the repairs were good enough, the assistant could be turned off.

Another advantage is that real heart can be used to time the beat of the assistant. All the nervous and hormonal signals that change the rate of the heart beat keep working. They are cut off when a heart is completely replaced.

"What has to be done is not replace the heart itself, only its function," says Dr. Kantrowitz. "We feel that it isn't necessary to take the heart out and throw it away."

On the other hand, Dr. Willem Kolff, who has led the work on a total heart at the Cleveland Clinic, argues that in many cases "the patient, rather than getting better, will only get worse . . . I believe that ultimately the number of people who will need total replacement will be very much larger than those who can be helped with an assisting device."

Whichever approach wins out, the assistant heart will probably be installed first. The Maimonides model, says Dr. Kantrowitz, is reaching the point where the team must ask themselves, "If we have a device which we feel certain will restore a patient to a useful and productive—though somewhat restricted—life, do we have the ethical right to withhold it from him?"

Many overseas jobs require training of local personnel such as these industrial foremen, at summer workshop in Taiwan.

Science overseas: jobs galore

by Curtis W. Casewit

PROFESSIONAL recruiters tell us that scientists have the best professional future. Many foreign situations actually go begging—especially for 15 kinds of engineers, for geologists, metallurgists, and for hundreds of other technologists.

You only have to look at the classified section of the newspaper. Which professional group gets the biggest want ads? Where is the great demand and the short supply? In the sciences. To be sure, the American brand of applied science has been appreciated in other countries.

According to a Canadian state employment bulletin, the expanding Far North will create a need for civil and chemical engineers during the next 10 years. U.S. scientists or skilled personnel can get a health checkup and a look-see of their papers at the border, and they're across.

In Pakistan, a flock of American companies are deploying their water and construction specialists to develop the Indus River, build irrigation links, install power plants—all to the tune of $5 billion. In Africa, U.S. mining engineers help produce 53 of the globe's 57 minerals and metals. Africa has no less than 40 percent of this planet's water-power potential, and craves engineers. The Snowy Mountain project in Australia will require hundreds of additional applied scientists for the billion-dollar hydroelectric and irrigation layout—one of the world's largest—which won't be completed

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Condensed From "How to Get a Job Overseas". © 1965 by Curtis Casewit, published by Arco Books, 219 Park Avenue South, N.Y.C.

for at least 9 years.

The governments of Turkey, Ceylon, Greece, and Yugoslavia have invited American experts to their countries. "The hottest international need is for electronic engineers," says Edward Isaacson, a recruiting specialist.

Technician's future

The United Nations personnel departments in Geneva and New York also paint the technicians' future in the brightest colors.

Here is how a UN personnel recruiter delineates a UN expert: "They must be senior people in their professions, possessing sound academic backgrounds and long practical experience. It is only rarely that the expert has fewer than ten to fifteen years of experience in his field. More often he has had twenty-five years or more. The age group ranges mostly from forty to sixty-five.

"Technical assistance assignments go from a few weeks up to a year or more, the majority of them being for a fixed term of twelve months. Occasionally the posts are extended for a further period, and some experts initially appointed for one year have remained in United Nations service in the field for several years on successive assignments in one country or another."

Pay is excellent for UN personnel. For assignments of one year or more, certain allowances (post adjustment, dependency allowance, installation grant, assignment allowance, service benefit, education grant) are paid to assist the expert in meeting the additional costs arising out of his overseas assignment. These allowances add from twenty to fifty percent to the base salary. The expert may be accompanied by his wife and children at the expense of the United Nations. This covers all children under the age of 18, and those between 18 and 21 who are in full-time attendance at a school or university.

Individual recruiting

Scientists and experts of one kind or another—at good salaries—are also needed by many of the other UN agencies, all of whom recruit individually.

If you are hired for a specialty, you can have the pick of 100 countries in the world, because the UN operates practically everywhere.

The oil field is equally job-rich for the specialist. Take Alaska. At least twenty American oil companies are exploring or producing in that northern state. One peninsula is yielding 30,000 barrels a day from some 50 wells, and when they run dry, there's more oil elsewhere. Two of the companies—Shell and Standard Oil of Indiana ("Pan Am Petroleum") are the big ones in the flock, and because it's cold and often lonely in the 49th state, turnover opportunities will let in newcomers for years to come.

The same applies to the giant, Aramco. You may have never heard of the mighty Arabian American

Each year, jobs outnumber qualified applicants.

Oil Company, which is owned by Standard Oil of California, Texaco, Standard Oil of New Jersey, and Socony Mobil Oil. Aramco employs some 1500 Americans—mostly scientists—in the hot, rich northeast corner of Saudi Arabia.

American oil people have such a fine world rating that they often find their way into foreign companies, too. Our oil geologists, for example, bask in the sun of the Dutch West Indies, where several thousand U. S. experts are employed by the Dutch-owned Lago refinery in Aruba. Other chances exist for *Yanqui* knowhow in South America. Here, resources are endlessly being discovered.

Mile-long list

One of the best employers for overseas specialists in South America has always been the Agency for International Development. It needs a mile-long list of technical people, starting with civil, electrical, electronic, industrial, mechanical, sanitary engineers to water drilling superintendents, soil scientists and geologists. You name the scientist, they need him—at salaries ranging to $19,650 a year.

In addition, AID administers our Foreign Assistance Program in the Far East, Near East, South Asia and Africa. As guests of some eighty host countries, AID only hires mature technical "specialists of recognized stature," as one official explains.

Actually, government agencies are not alone in insisting upon the highest standards; private firms want the best caliber, too. The director of Lead International, which helps over one hundred American scientific giants like GE and RCA with their recruiting, tells us that there are not even enough graduates. Lead Consultants has had as many as nine hundred unfilled orders for scientific programmers and radar technicians. "A degree plus two years' experience would have been sufficient," says Edward Isaacson of this technical management agency which charges no fees. Isaacson points out that South American contracts have been lost because recruiters couldn't drum up the needed number of communication engineers. "There just isn't enough qualified talent around," Isaacson adds.

The theory was explored not long ago when the heads of America's 150 most active construction companies met at a university symposium in Boulder, Colo. Since these companies get the lion's share of our overseas contracts, they wanted to share their experiences involving American technologists on foreign assignments.

No holds were barred in the discussion, and the sparks flew. At

one point, an executive said: "I can tell you why these engineers want to go overseas. For only three reasons: Money, women, and booze!" A construction company president said bluntly: "A lot of our technicians just want to be playboys over there, and get on the gravy train!"

According to the symposium, the companies found that the most pressing need was not only competence, but "pinch-hitting" scientists, i.e., men with "primary, secondary, and even tertiary" skills. Emotional stability, pride in the job and good health are important qualities, too. Only one in ten applicants seemed to have all this.

No 9 to 5 schedules

And the overseas technologist really has to put out. He often works twice as hard as back home. During the rainy season, for instance, he may have to work 12 hours a day, 7 days a week. Customers of the large U. S. consulting companies are often foreign governments or foreign businesses. Thanks to this bonanza, one such company, Engineering Consultants, Inc., a Western firm, has grown in 10 years from a mere five engineers to 125.

But there is room for individuals, too. Every year, the "Committee on Manpower Opportunities in Israel" runs additional want ads for plant technicians, instrumentation engineers, computer programmers. An American diamond mining engineer will find a hearty welcome in South Africa. The Republic of Nigeria often advertises for scientists in the *New York Times*. And any shrewd engineer can gather a dozen good leads from the "Construction Projects" pages of the *International Commerce Magazine*.

Foreign employers

Or consider these: With headquarters in London, the Anglo-American Mining Corporation has used American mining engineers for a project in Australia. Associated Engineers, which supervises dozens of British factories, has a payroll of 14,000, including Americans; others are working for the London-headquartered Esso Company. The Ministry for Greenland in Copenhagen, Denmark, often finds itself short of Danes to work the long, lonely hours in the north, and has employed young, not-too-fussy Americans.

But since experienced men of science can be fussy about where they want to work, they may as well stick to foreign opportunities offering transporation, health benefits, security, and $7,000 to $12,000 contracts, that can be leisurely considered at home.

Consider these:

National Bureau of Standards. The Central Radio Propagation Laboratory of the Boulder Laboratories maintains isolated bases in Antarctica. The tour of duty involves approximately a total of 18 months with 12 months in Antarctica. Engineers and physicists with specialized experience in the opera-

Hawaiian sun, Alaskan snows beckon via Federal jobs.

tion and maintenance of radar, guided missiles, or with other complicated electromechanical and electronic systems should send inquiries to the Personnel Officer, National Bureau of Standards, Boulder Laboratories, Boulder, Colo.

Weather Bureau. Weather stations are maintained in Alaska, Puerto Rico, Hawaii, Wake Island, Guam, Canton Island, the Trust Territories and on the Antarctic continent. The Bureau also cooperates with the Canadian Government in maintaining several stations in the Arctic region. Persons with experience in weather or electronics, who are interested in employment with the Weather Bureau outside the U.S., should send inquiries to the U.S. Weather Bureau, Washington, D.C., 20235.

Geodetic survey

Coast and Geodetic Survey. Geomagnetic observatories are located in Alaska, Puerto Rico, Hawaii, Guam, and on the Antarctic Continent. Geophysicists interested in employment outside the continental U. S., should send inquiries to the Director, Coast and Geodetic Survey, Washington, D.C., 20230.

Bureau of Public Roads. Highway design, planning, construction, maintenance, bridge engineers and specialists with experience in the administration and supervision of the operation and repair of highway construction equipment provide technical assistance to countries in the Near East, Africa, Asia, and South America in connection with the Government's overseas technical aid program. Highway and bridge engineers also work for the Bureau in Central America on the construction of the Inter-American Highway. Inquiries should be sent to the Bureau of Public Roads, Washington, D.C., 20235.

Bureau of Land Management. The Bureau directs the survey, management and disposition of public lands in Alaska. This includes the protection, use, and development of forested areas; the survey, classification and appraisal of public lands as to their best use; and their subsequent disposition or lease. From time to time, appointments are made to fill forester, agricultural economist (lands), cadastral engineer and range conservationist positions. Inquiries should be directed to: Area Administrator, Bureau of Land Management, P. O. Box 1481, Juneau, Alaska.

Bureau of Mines. The Bureau of Mines employs mineral technologists, mining engineers, metallurgists, and technical specialists to work in foreign technical co-operation projects. The location of such

assignments is dependent upon the activities of the foreign technical co-operation organizations of the government. Address inquiries to: Chief Personnel Officer, Bureau of Mines, Department of the Interior, Washington, D.C., 20225.

Mineral industries

In Alaska, mining engineers perform work in mining methods, development of mineral resources and mineral industry surveys. A few metallurgists are also employed. For information, write to: Bureau of Mines, Federal Building, P. O. Box 560, Juneau, Alaska.

In addition, the Central Intelligence Agency offers many scientific posts. A scientist can walk into its recruiting office at 1016 16th Street, Washington, D.C., without prior appointment. Or he can offer his cloak-and-dagger services, in writing, and get back an answer in an unmarked envelope. For women, one of the interesting possibilities is the military establishment overseas. The WAVES in the next few years will need 1) female mathematician-programmers who know analytic machine equipment; 2) specialists for the quality evaluation labs in our foreign ammunition depots; 3) research chemists in the radiation field.

In the Air Force, there are careers for enlisted men to learn about electronic communication systems, nuclear weapons, radar, aircraft navigation equipment and digital data systems. Furthermore, the USAF is one of the nation's largest employers of civilians. There's room for the anthropologist, architect, astronomer, cartographer, chemist, economist, engineer, entomologist, geodesist, geographer, historian, mathematician, medical officer, metallurgist, meteorologist, navigation specialist, operations analyst, physical science administrator, physicist, psychologist and statistician.

Moderate pay

Salaries are lower than in private industry, except for the top-level scientific personnel, who earn between $16,000 and $20,000 a year. All levels of personnel seldom work more than 40 hours a week.

There are Air Force bases in almost every state, including Alaska and Hawaii. Overseas, there are jobs in Europe, Africa, Japan, and the islands of the Pacific. Occasionally, vacancies occur in Puerto Rico and the Caribbean.

But note that appointments to Air Force civilian positions are made only by the U. S. Civil Service. Thus: 1) scientists with civil service status always get preference; 2) scientists now on the payroll of other government organizations hop aboard first, via a transfer; 3) there is always a waiting list of so-called eligibles for the lower rungs of the scientific fraternity. In short, jobs are only easy to get for the most experienced and the most qualified. (The same holds true for private industry.)

Yet there are advantages to the Civil Service, too. For one thing, the merit system and the examinations are worked out in such a fine style that you'll get a preference on the basis of competence rather than whom-you-know. For another thing, Civil Service consideration is given without regard to race, creed, color or national origin.

The hundreds of engineers who join the Navy as civilians and stay civilians are also former or present Civil Service people who get the juicy posts through transfers. On the other hand, newcomers can take the Civil Service exams, too. If nobody else is on hand, they'll get on the payroll, which goes from $5,795 to $11,725 per annum, plus differentials. Job locations range from Guantanamo Bay, Cuba, to Naples, Italy. (Think of nearby Capri, Sorrento, Positano.) The Navy also sends engineers to the Canal Zone; El Ferrol, Spain; to chilly Kodiak and Adak in Alaska, and equally cool Keflavik, Iceland. To make up for the cold, there is a warm 15 to 25 percent more pay than in the States.

Nice work if you can get it. And you probably can.

What about jobs at home for the 1966 graduate? See the article below.

How to get a science job at home

by John A. Kraft, Jr.

IF YOU'RE among the science grads in a class of '66, what are your job opportunities?

Prospects for seniors in colleges across the nation have never been better. Recruiting drives by business, industry, government and the colleges place a premium on higher education.

As always, there are sound reasons behind the top starting salaries offered to science majors. The principal one is the stiff competition from educational institutes and government:

Colleges seek prospects for classroom work. A prof has many chances to influence the better pupils. An appeal to "stay with Tech" is difficult to resist. After four years of pretty coeds, colorful bands and championship football, even non-athletes get a campus complex.

Civil Service career opportunities. Special provisions make it possible to recruit college graduates in a grade level of GS-7. This has an annual starting salary of $6,209.

Student applicants who have completed or expect to complete within nine months "one year of full time study at the graduate level leading toward a master's degree at an accredited college," can take the Fed-

Recruiters dangle fat paychecks before graduates.

eral Service Entrance Examination to qualify for a GS-9. Wages in this classification begin at $7,479.

Universities beckon bachelors of science. Students who continue their education can qualify for higher salaries with business and government.

With pressure from these areas closing in on the graduating classes, fatter pay checks from business and industry are an important factor.

What are the corporate starting salaries in the scientific fields?

A survey of some 111 colleges and universities made recently by the College Placement Council of Bethlehem, Pa., showed wages up 2.6 percent over last September. They now average $630 a month, with categories like electronics, chemistry, pharmacy and aerospace bringing $632 to $639.

The salary level for physics majors, reported by Northwestern University, was $616 a month; math and statistics grads averaged $571.

A detour for many college men is the stint of military duty.

To fill its obligation for officers, the Army draws heavily on the ROTC undergraduate program. Navy accepts degree holders in its Aviation Officer Candidate Program. These applicants are eligible for 16 weeks training at Officer Candidate School, and qualify for appointment in the line or staff corps.

A science degree is honored by the Air Force, making the holder eligible to attend a 12-week precommissioning course. If he is successful, he is appointed to the rank of second lieutenant in the Reserves and assigned to non-flying duties.

After the service

If a graduate has finished his military service, job opportunities in the expanding economy are especially attractive.

Industry is stripping down to its checkbooks in order to obtain desirable science majors. Besides the exhibits and displays in the halls of higher learning, industry is spending heavily on speakers who can sell promising grads on joining their work forces.

Ford Motor Company draws attention to its scientific and technological progress by sponsoring a unique, gas turbine truck. The futuristic vehicle has made a 12,000-mile tour of college campuses and is heading for additional ones.

Many business firms send recruiting teams instead of individual representatives to contact students. They find it effective in a number of ways. Engineers, for instance, discuss job openings with engineering students, and biologists interview biology students. In this manner, a science senior gets to talk shop with a "pro" in the field. It also enables a company to contact

a greater number of scholars.

The graduate can profit by seriously evaluating his interests and abilities. He should try to develop a relaxed, confident attitude and a good speaking voice.

To take advantage of the excellent opportunities offered them, science students interested in career jobs should:

* Check with their college placement office to obtain information regarding the lists of employment openings. Be sure to note the dates for interviews and the requirements for job applicants.

* Attempt to analyze advancement possibilities in the company selected.

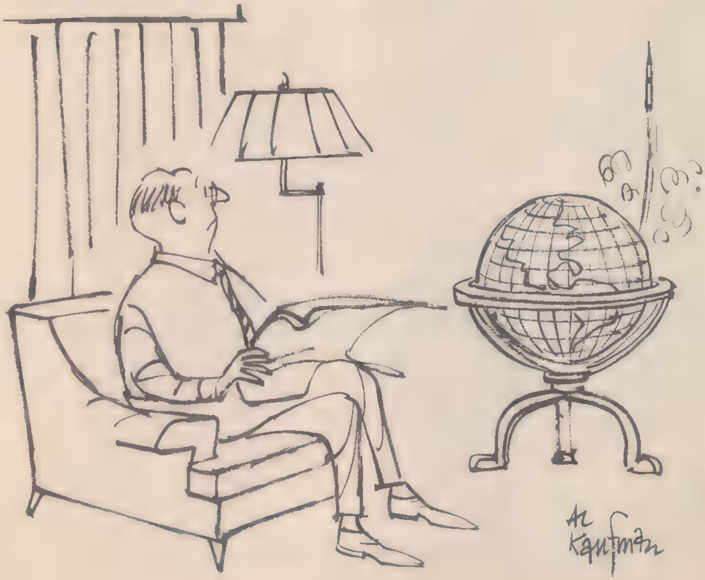
* Get their name placed on the firm's interviewing roster.

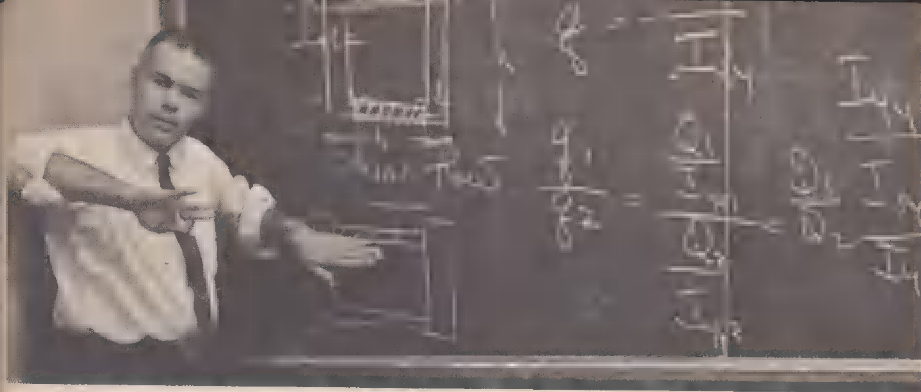
* For information regarding specific companies (size, products and financial status), check the Thomas *Register of American Manufacturers* or *Dun & Bradstreet's Reference Book*.

Long range rewards

Keep in mind that while the starting salary is important, it is well to make a connection with a company that looks ahead and rewards individuals with initiative and courage.

More than 1,750 corporate and government employers will vie for services of the 1966 graduating class. The chances to begin a challenging career with an alert, progressive firm were never better!





Assoc. Prof. Gerald Horne teaches a metallurgy class. Faculty-student ratio is 1/9.

Carnegie Tech—where science meets art

ORIGINALLY, Carnegie Tech was conceived as a trade school for Pittsburgh steel mills. Apprentices could study sheet metal working, electric wiring, plumbing and forging. Then came apprentice courses in sign and house painting, the forerunner of today's College of Fine Arts. After that, technical courses sprang up and overtook the journeyman trades.

Now, doctorates are offered in virtually every field. Carnegie Tech ranks fourth among private institutions awarding engineering Ph.D. degrees. And in research, 230 separate projects, worth $7 million, will be active in 1966-67.

Tech pioneered the concept of a liberal professional education for engineering coursework—at least 25 percent in humanities. Schools everywhere followed the pattern.

Hunt Library, centrally located, is part of a current campus building expansion.

Fine arts students are screened before acceptance. Rigorous schedules emphasize learning through doing original work.

Hunt Library is ideal for browsing. Open stacks house 235,000 books, 50,000 journals. To keep information current, almost as many books are withdrawn as are added.

The 87-acre campus sprawls near Schenley Park in Pittsburgh. Recent buildings include a library, student activity center, engineering hall, stadium and dormitories.

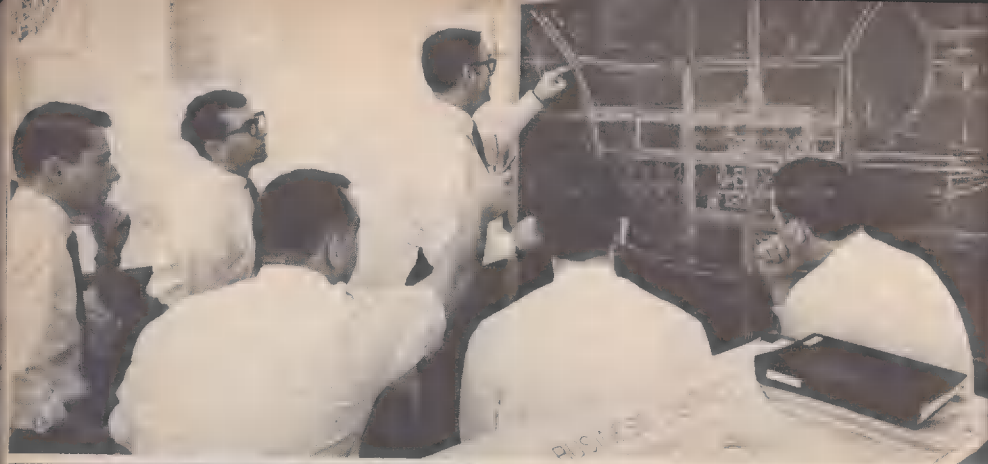
FOUNDED as a "College of Industries" in 1900, Carnegie Institute of Technology was given to the City of Pittsburgh by Andrew Carnegie.

In 1905, it held its first class. In 1912, it began conferring degrees. In 1914, the first master's was awarded and Carnegie offered the first drama degree in the U.S. Today, it offers depth schooling in fine arts, science and technology.

The Graduate School of Industrial Administration, founded 15 years ago, is considered one of the top two or three university-related business schools in the U.S. Math prerequisites underscore the stress on quantitative methods.

Carnegie Tech is proud of its dual excellence. "The glory of having a creative College of Fine Arts on the same campus as a College of Engineering and Science," says President H. G. Stever, "is not so the engineer and scientist can relax at a good show or concert or exhibit in the evening, though that is pleasant, but so the faculty and students are exposed to quite different forms of human thought, expression and action."

Lowly freshman status is marked by a dink. Outside the classroom are fraternities, sororities, a glee club, sports, TGIF parties, a campus radio station and technical journal.



Above: Architecture students are well-versed in physics and regional planning after 5-year program. Dr. David T. Lewis (at board) is an urban planning expert.

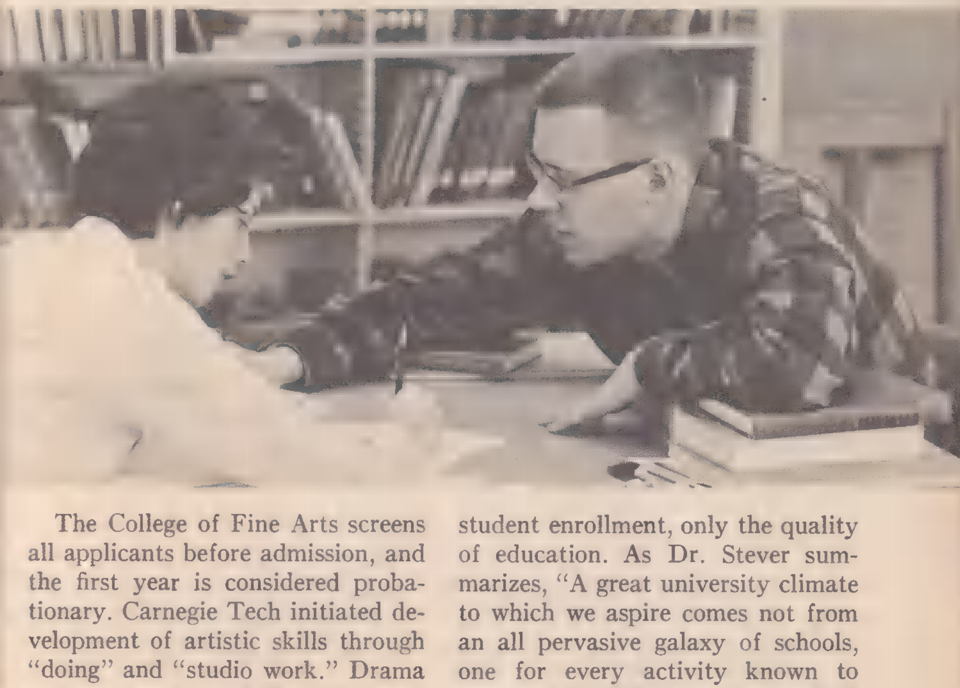
Left: Dr. H. G. Stever, Carnegie's new president, was M.I.T. faculty member, research advisor to NASA and Congress, former Chief Scientist of the Air Force.

Right: Women make up one-third of the student body. Alumnae programs offer "continuing education" to keep working skills from rusting during family days.

Below: Reactor is the heart of 63-acre Research Center in Saxonburg, 30 miles from the main campus. Many high energy physics experiments are conducted here.

A CARNEGIE education is broached as a way of learning, a unity of approach as the basis of continuing education. The constant battle is to avoid obsolescence.

A privately endowed and financed school, Carnegie Tech has spent $20 million on new construction since 1957. A $5 million grant last spring will expand the Computation Center and an inter-disciplinary program in Systems and Communication Sciences.



The College of Fine Arts screens all applicants before admission, and the first year is considered probationary. Carnegie Tech initiated development of artistic skills through "doing" and "studio work." Drama students are warned that "it is impossible to permit you to hold regular outside employment" because of the concentrated schedule.

The Graphic Arts Center offers two undergraduate programs, one in design, one in management. Carnegie Tech leads in recognizing the study of printing as an engineering, science field.

Programs for professionals and alumni include a series of engineering courses tailored to fight obsolescence. A Program for Executives was established in 1954. The nine-week course is limited to 25 top echelon leaders.

This year, there are 3,006 undergraduates on campus and 969 graduates. There is no drive to expand student enrollment, only the quality of education. As Dr. Stever summarizes, "A great university climate to which we aspire comes not from an all pervasive galaxy of schools, one for every activity known to man, nor in fact within each school from a covering of every subject possible. It comes from the depth of kinds of work done."

This is the fifth in a series on America's top science schools.

KFS
A Nigerian girl with leprosy gets her weekly dose of sulfone tablets. Administered for two to three years, the drug prevents crippling. A new compound works more rapidly.

Coming—leprosy's end

With new drugs, the world's dreaded scourge may soon be brought under control. A vaccine would wipe it out.

by Earl Ubell

EVEN though doctors have had an absolute cure for leprosy for 24 years, the disease still terrifies some 12 to 20 million persons around the world. In the United States, the crippling ailment has 2,000 patients in its thrall.

In recent years, public health men have given this old disease increased attention. They have, obviously, been trying to cure as many patients as possible. They are testing a vaccine against it. And, they have worked hard to remove some of the stigma attached to the leper.

Of course, that program fights against tremendous odds, not the least of which are superstition, fear, poverty and the cantankerous nature of the disease. The bacteria of leprosy do their dirty work over a long period of time: they invade the skin to create light scaly patches devoid of the sense of touch;

they destroy nerves and that causes permanent contractions of muscles; finally, they cause the body to reabsorb bones.

The loss of the sense of touch—anethesia—makes the leper vulnerable to cuts and bruises; contraction of muscles turns arms and legs into useless, hanging appendages; and the reabsorption of bones turns fingers and toes rubbery. In the end, the victim dies of pneumonia or some other infection. The time periods: 10 to 15 years.

Cure in 1943

In 1943, Dr. Guy Faget, a physician at the Carville, La., Leprosarium, discovered that a drug called sulfone stopped the disease in its tracks. If the treatment is continued for two to three years, there is no crippling, and the production of new bacteria is stopped. More recently another compound, also a type of sulfone, called DDS, has been found to work even more rapidly.

Despite that discovery more than 20 years ago, little has been done around the world to cut the toll of leprosy, which, because of its crippling effects, actually cuts down on agricultural and industrial production in just those countries which need healthy men the most. In some parts of the world, 5 percent of the adult population has leprosy. It is a way of life in parts of India, Africa, New Guinea and Southeast Asia.

To stop the spread of infection, public health workers know they have to isolate the patient during treatment to treat him effectively enough to prevent relapse. In the United States, Hawaii and Louisiana sanitaria provide the necessary isolation. But such a course is clearly impossible for a poor nation which has several hundred thousand lepers—it would mean supporting such individuals at tremendous cost for four to five years.

The World Health Organization has suggested outpatient clinics. Unfortunately, countries which need them most do not have enough nursing and other medical personnel to man such facilities.

Recently, Dr. Richard S. Buker, a missionary in Thailand, suggested in an article in the *Journal of the American Medical Association* the establishment on a wide scale of self-supporting leper villages. In those places, lepers would live and work, never leaving their villages. In those circumstances, Dr. Buker says, a few medical people could make sure that the patients are treated and infection confined.

Source of infection?

Such a scheme has strong opposition. Many medical people believe that leper villages provide a source of infection, although Dr. Buker has evidence to the contrary. Primarily, there are the ancient superstitions and fears concerning the ailment. One idea that circulates is that a single touch of a leper is sufficient to infect. While scientists

Biblical lepers actually suffered another disease, perhaps psoriasis.

do not know the exact mode of transmission from person to person, they know that leprosy is no more infectious than tuberculosis, to which it bears a resemblance both as to the type of bacterium involved and the damage it does.

Moreover, since TB is sufficiently infectious to cause epidemics in the right circumstances, the infectivity of leprosy is not to be pooh-poohed. Up to 30 percent of children and 5 percent of adults living in a household with a leprosy patient come down with the disease, albeit frequently in a self-induced form. Like TB, leprosy thrives where malnourished people live in close quarters.

In the Western world, much of the horror of leprosy stems from Biblical references to it: the leper was deemed too unclean to participate in religious ceremonies. Yet, recent examination of the bones of individuals who lived in Palestine in the pre-Christian era shows no evidence of leprosy.

Scientists trace the introduction of leprosy into the Holy Land no earlier than the 2d century and into Europe no earlier than 700 AD. The Biblical lepers must have suffered from some other skin disease: perhaps it was psoriasis, which to the untrained eye looks like the skin symptoms of leprosy but to which it bears absolutely no relation. Dr. Charles E. Shepard, a leprosy expert at the Communicable Disease Center at Atlanta, Ga., believes that there is a problem of translation from Hebrew to Greek to English. The Hebrew word refers, he says, to a generalized skin ailment; the English translators of the King James Version have used leprosy to denote the same conditions.

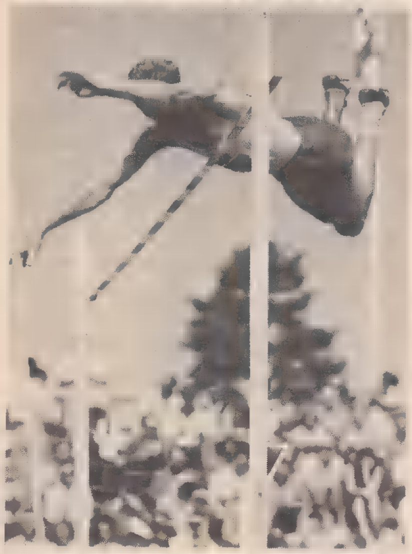
The greatest hope for the worldwide problem is in prevention by a vaccine. Because tuberculosis is so similar to leprosy, scientists hit upon the idea that a TB vaccine might protect against a leprosy bacillus. They hit upon BCG, a weakened tuberculosis germ that has been used against TB.

At the moment, two carefully controlled field trials of BCG against leprosy are going on in New Guinea and East Africa. In a few years, the scientists should know if BCG best protects against leprosy.

Even better, of course, would be a vaccine composed of weakened or killed leprosy bacillus. But no scientist has succeeded in growing the germ outside of a living cell.

If BCG works, or if a better vaccine can be developed, scientists would be able to clean leprosy out of most countries in a generation. Thus, the disease is a demonstration of the old irony in medicine: a cure rarely eliminates a disease from a population; a preventative almost always does.

PLEASE EXPLAIN



KFS

It is widely believed that athletes need a heavy protein diet for top performance.

Should athletes eat protein?

Do heavy protein foods such as steak and eggs give an athlete more stamina and strength?

The idea that eating meat or "muscle," would replenish muscle is believed to have begun in the Greek town of Stymphalus around 500 B.C. A trainer put athletes on a heavy meat diet and when they became successful, the traditional athlete's vegetarian diet was abandoned.

Although some coaches cling to a meat-dominated diet, Dr. Donald Cooper, team physician at Oklahoma State University, is one of the majority who advocate a balanced combination of proteins, carbohydrates and fats.

In fact, proteins should actually be avoided in a pre-event meal. The digestion and metabolism of protein leaves an acid residue in muscle which can be excreted only via the kidneys. Thus, athletes who eat steak or eggs are more likely to suffer cramps and fatigue. On the other hand, acid from metabolism of carbohydrates and fats is mostly carbon dioxide which leaves the body via the lungs or sweat.

If that is not convincing enough, carbohydrates are 10 percent more efficient in utilizing oxygen than proteins or fats. One liter (about a quart) of oxygen yields five calories if it burns carbohydrates but only four and a half calories of protein or fat.

Preferred pre-game meals include a well-balanced liquid formula, toast with honey, oatmeal, weak tea with sugar or peaches in heavy syrup. Although Dr. Cooper does not believe that meals in the 48 hours before an event can aid an athlete's performance, at least harmful foods can be avoided. Cramps, delayed emptying of the stomach, depleted salt stores or inadequate energy supplies can be avoided through proper foods.

Dr. Cooper also recommends that the final pre-game meal be eaten three or more hours before the contest: "Much of the traditional pre-game meal never gets out of the stomach, so it cannot do anything but harm."—*J.R.*

Please explain the properties of cosmic rays and neutrinos and how they differ.

Cosmic rays consist of speeding subatomic particles of considerable mass, which carry positive electric charges. About 90 percent of the particles are protons (hydrogen nuclei) and nine percent are alpha particles (helium nuclei). The remaining one percent are nuclei of more complex atoms. Nuclei of atoms as complex as iron, with 56 times the mass of a single proton, have been detected.

Because cosmic ray particles are so massive and move with such enormous velocities (nearly the speed of light) they carry a great deal of energy. They are the most energetic particles we know, in fact, and some cosmic ray particles are billions of times as energetic as anything that can be produced in the very largest accelerators.

Cosmic ray particles smash into the Earth's atmosphere, breaking up any atoms they encounter and producing floods of "secondary radiation" consisting of a variety of particles, including mesons and positrons. Eventually, the radiation smashes into the Earth itself, some of it penetrating many yards into the ground before being absorbed. Such particles can bring about changes in any atoms they encounter, including those in the human body. The changes so brought about might, conceivably, produce diseases such as leukemia. They might also induce mutations. For any given individual, however, the chances of this happening are small, for almost all cosmic ray particles that happen to strike a particular person pass through him without significant harm.

The exact source of cosmic ray particles and the manner in which they gain their enormous energies are matters of dispute.

Neutrinos are produced, along with electrons, positrons or muons, in any nuclear reaction that produces any of the latter. The nuclear reactions that go on in the Sun, for instance, produce large quantities of positrons and therefore produce large quantities of neutrinos as well.

Neutrinos, which travel at the speed of light, are even faster than cosmic ray particles, but are much less energetic, for neutrinos are completely without mass and electric charge. Neutrinos are not absorbed by matter unless they make a direct hit upon an atomic nucleus, and this happens so rarely that they can, on the average, pass through trillions of miles of solid lead without being absorbed.

Thus, the countless trillions of neutrinos produced by the Sun every second streak out in all directions. Those that happen to be aimed at the Earth strike us, then pass right through the planet as though it were not there. They pass through all of us as well. We are

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bombarded by neutrinos constantly day and night all our lives. Since they pass through us without being absorbed, however, they do not affect us in any way.

It is possible, of course, that a particular neutrino may, through a very lucky chance, make a direct hit on an atomic nucleus just when it happens to be in our vicinity. It can then be detected. In the last ten years, physicists have learned how to take advantage of these rare instances. Neutrinos may now serve to give us information about the interior of the stars (where they are formed) which we could not have learned in any other way.—*Isaac Asimov*

I have often noticed that wild birds will ignore a person until he gets a certain distance from them, then they will fly away. It seems that the distance is always the same for each species of bird, but that different species will tolerate different distances. Is this just an illusion?

It's no illusion. Animal psychologist H. Hediger points out that each animal has a "flight distance," the distance to which the animal will allow a potential enemy to approach it before it runs or flies away. Larger animals usually have longer flight distances. An antelope will run away if a man gets within five hundred yards, a sparrow will allow him to approach within six feet. Hediger has also established that many animals also have a second territorial zone called "critical distance." The approach of an intruder beyond the flight zone into the critical zone may turn retreat into attack. Critical distances for some animals are so exact Hediger has found that they can be measured within inches. In order to keep a wild animal successfully in a zoo, its flight and critical reactions must be modified significantly.

Writing in *Natural History Magazine,* Anthropologist Edward T. Hall states, "A lion in a zoo will flee from an approaching man until it meets an insurmountable barrier. If the man continues the approach, he penetrates the lion's critical distance; then the cornered lion reverses direction and begins slowly to stalk the man.

"In the classical animal act in the circus, the lion's stalk is so deliberate that he will surmount an intervening obstacle such as a stool in order to reach the man. To get the lion to remain on the stool, the lion tamer quickly steps out of the critical zone. At this point the lion stops pursuing. The trainer's elaborate 'protective' devices—the chair, the whip or the gun—are so much window dressing."

The establishment of "flight distance" and "critical distance" is just part of the information coming out of the growing field of study known as animal territoriality. The general impression is now that wild animals do not move about and act at random but are rigidly bound by territorial needs. A greater knowledge of these may contribute to knowledge of man's reactions to isolation and overcrowding.—*D. C.*

QUIZ

How to spend the winter

KFS

Folk tales say spring is far away if a groundhog sees his shadow on Feb. 2.

by John and Molly Daugherty

MAYBE we'll be able to hibernate through our troubles someday! Scientists are studying the mechanism that slows down body processes by using injections from the brain of a ground squirrel to induce hibernation in cats and dogs, mice and rats.

Some animals can protect themselves in one of three kinds of dormancy: (1) hibernation or winter sleep, which may be either partial or complete; (2) estivation or summer sleep during heat and droughts; and (3) diurnation or daily sleep.

What do you know about this mysterious conservation of energy?

1. If an astronaut were chilled quickly and uniformly so he could hibernate part of the way through space on an interplanetary trip, at what body temperature would he regain his hearing and vision as he thawed out?
   a. 94°F
   b. 86°F
   c. 90°F
2. Bird hibernation is rare. The bird that's a true hibernator is the
   a. Oil bird
   b. Hummingbird
   c. Poorwill
3. During the big sleep, bears
   a. Maintain a relatively normal temperature
   b. Lose no weight
   c. Are insensitive to all disturbances
4. One animal that doesn't hibernate is the
   a. Grey squirrel
   b. Chipmunk
   c. Skunk
5. Diapause, the long quiescent period—whether hibernation or estivation—is terminated in the caterpillar by

a. The ripening of fruit in the fall
b. A physiological clockwork system disregarding environmental changes
c. Environmental changes

6. The amphibian that waits for a low temperature to warn it to get ready for inaction is the
   a. Toad
   b. Northern two-lined salamander
   c. Greenhouse frog
7. The animal that isn't gregarious when it goes off somewhere to hibernate is the
   a. Bat
   b. Woodchuck
   c. Snake
8. The turtle of a species in the genus *Graptemys* that may hibernate in a muskrat house is the
   a. Box turtle
   b. Musk turtle
   c. Map turtle
9. Woodchucks live during the winter on
   a. Fat stored in their bodies until a mild February
   b. Food found when they leave their burrows from time to time during the winter
   c. The food hoard they've stored away in their hiding places
10. Warm-blooded animals, compared with animals of variable temperature, hibernate for periods of time that are
    a. Shorter
    b. Longer
    c. About the same

Answers:

1—a 94°F. At 90°F his body thermostat would become active. At 86°F his pulse would return, and his blood pressure could be measured.

Patients who cannot be anesthetized without great danger have undergone surgery successfully when their bodies have been cooled to 77°F.

2—c The poorwill, called "the sleeping one" (hölchko) by the Hopi Indians. The poorwill's normal temperature is 106°F. It drops to 64.4° in hibernation. No heartbeat can be heard; no breathing noted. Its metabolic state is very low.

The oilbird or *guacharo* of Central America lives in caves but goes out for food at night. The sonar system of oil birds is like that of bats.

The metabolism of the hummingbird is extremely high during the day (when it feeds on flower nectar). It drops low every night. Otherwise the hummingbird would use up its reserves too fast.

3—a Their temperature is relatively normal. There is disagreement as to whether bears truly hibernate. Their metabolic activity is reduced, although it is only partially dormant.

They lose weight—sometimes 25 percent over a three-month sleep.

They are sensitive to noise and other disturbances. Don't trust a hibernating bear not to wake up!

4—a The grey squirrel doesn't hibernate, but it becomes inactive. It doesn't store much food.

The chipmunk in the North hibernates from November until March.

The skunk depends on its stored-up fat for energy to stay alive while it's sleeping through the winter.

5—b Caterpillars are dormant at the proper time for *them,* regardless of environmental changes, and they become active "like clockwork." They have their own inner clockwork system, which is more reliable than environmental factors.

Caterpillars grown under artificial light, however, have been made dormant by experimenters, but light has

had more influence on the length of hibernation than temperature.

6—b The Northern two-lined salamander. It perhaps is not a true hibernator even though it is sluggish and less active in very cold water.

The toad digs hibernation quarters before cold weather arrives.

The greenhouse frog doesn't hibernate at all, so it limits the northern range of its activities. It is little more than an inch long and lives in Florida.

7—b The woodchuck or groundhog. He usually hibernates alone or in pairs. He goes into his burrow fat and comes out lean and hungry for both a mate and a meal. February 2 at 11 A.M. is the time to watch him come out to see his shadow, according to superstition.

Bats hibernating hang upside down by the hundreds from ceilings or walls of caves.

Many snakes, sometimes of different species, occupy the same burrow—often in a slope facing south.

8—c Map turtle (geographic terrapin). Its shell looks like contour lines on a map. The map turtle likes the muskrat's house with its good insulation—walls more than 4 inches thick. Although some map turtles of Northern Illinois hibernate in muskrat houses, others just burrow into stream banks or settle down to sleep in soft mud.

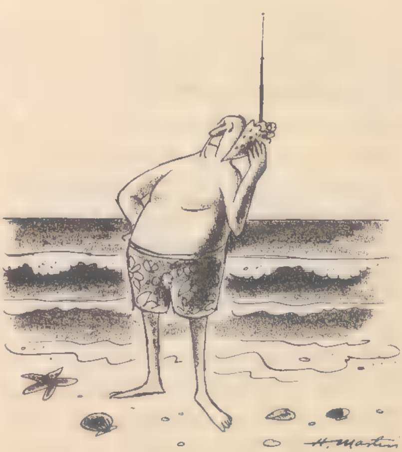
The box turtle is such a glutton he often gets too big for his box. Both front and rear halves won't both close at the same time.

9—a Fat stored in their bodies. Woodchucks hole up in an extensive burrow 4 or 5 feet deep and 25 to 30 feet long with 2 or more openings. They hibernate from October till February.

10—a Shorter. Animals with variable temperatures sleep all winter, but warm-blooded animals like squirrels leave their nests in mild spells of mid-winter weather. Opossums and raccoons wake up during periods of thaw.

Score Yourself:

9—10—You're no hibernator!
4— 8—Partially dormant, weren't you?
0— 3—Go back to sleep.



THE HUGH DOWNS COLUMN

Hugh Downs's thoughts on pain were precipitated recently when he had to wear a brace while he recovered from a slipped disc in his neck.

Some thoughts on pain

OVER the years, *Science Digest* has run many articles on the subject of pain written by scientists, doctors, psychologists and research experts. This is not one of them. The aim of this column this month is to raise a philosophic speculation about physical pain based on some scientific facts and some personal subjective observations, and beginning with the idea that there may be no such thing as pain.

There now, you with the aching back or head or tooth. I've got your dander up, and maybe if the feeling is strong enough, you'll get a little momentary relief from that very real pain in your back, head or tooth.

While not an adherent of the Christian Science faith, I have long admired the attitude it has toward pain. The phrase "There is no pain" cannot be dismissed lightly, even if you've just dropped a cinder block on your instep.

As with stoicism, Christian Science seems to take the wholly reasonable view that while the stimulus is real and can't be denied by the mind, whether it becomes pain or not is purely a matter of interpretation.

Until quite recently, medical sci-

ence dismissed this philosophic approach to defining pain on grounds that pain is conveyed by special nerve structures separate from those which bring us non-painful sensory information about heat and cold, pressure and contact.

Spinal relay points

A modern theory is that strong signals from many different kinds of nerves over a wide area are interpreted as pain by relay points in the spine. The interpretation is affected by the brain, but mostly acting unconsciously.

While there is a distinction between "pain perception" and reaction to pain, the so-called "reaction" (I will call it "interpretation") varies within wider limits than stimulus perception for given persons, and for the same person under differing circumstances.

How often have you been hurt enough to bleed or bruise under circumstances of great excitement or activity and not known it until later? It is possible to break bones and to lose your life in violence without physical pain. It has been suggested that the wretches eaten by lions in the Roman games may have been free of pain during the process of destruction. Soldiers wounded in battle and victims of auto accidents frequently report surprisingly little pain and discomfort.

Stimuli interpretable as pain, conveyed through their special nerve structures, must reach some sort of control center before they can be registered and interpreted. In other words, no pain exists in a foot or arm or back. But something happens in those places to send messages to the brain. It then decides if the message is to be regarded with alarm and loathing, if it is to be tolerated, or if in some cases it can be enjoyed. (A bowel movement is interpreted as painful by the infant, to whom it is unfamiliar and frightening, tolerable by the older child and often pleasurable by the elderly. Plainly, here is the same set of signals interpreted in opposite ways by human beings of different age and experience.)

Pain box

Quite recently a 'pain box' was developed at Massachusetts General Hospital which works on the principle of electrically confusing the area of the brain responsible for interpreting pain stimuli.

Dr. Hans Kraus in his book *Back Ache, Stress and Tension* tells of a quack named Elisha Perkins, who in the late 18th century sold a device called a "tractor"—two short metal rods which were supposed to yank pain from the body. They, of course, did nothing.

Strangely, the pain box at Massachusetts General involves two short metal rods—electrodes—installed in the patient's head and reaching to a certain center in the brain. But these rods work. For several hours after a mild shock the patient remains free of his intractable pain. This is not an anaesthetic process. There is no numbing of the

affected area or of the brain. It is now believed that the brain builds a code to inform the patient's consciousness that he has 'pain.' After this code is scrambled by the mild electrical impulse, several hours elapse before the brain can reassemble the complicated idea of pain from the messages, which of course have continued to come in from the affected area. Pain then becomes a fictitious character, written by the brain using the alphabet of nerve stimuli. When the book is burned by the jolt of electricity, the brain sets about to reconstruct its signals—to rewrite its fiction and convince the consciousness that there is pain in the body.

Pain center confused

Significantly, during the period the intractable pain is destroyed, the ability to sense hurt is not diminished. The patient, according to Dr. Frank Ervin, one of the developers of the electric pain box, is just as able to detect a pin-prick, or heat or cold, or any sense message, as if his brain's pain-center were not confused.

It is certainly normal and healthy for messages of tissue damage to be built into an idea of 'pain' (even though much suffering of this kind goes far beyond its initial function of filling the organism with urgency and alarm). Sometimes unhealthy emotions of guilt and self-hate cause a person to interpret messages of tissue damage not as alarming and painful, but as desirable. One of the Tarquin kings of ancient Rome, deeply guilty about a document he had signed, burned off his right hand by holding it over a brazier. We are asked to believe he did this without changing his facial expression. This is not only quite credible, to me it is evidence that pain is a fiction and has no intrinsic existence.

Pre-frontal lobotomy

Pre-frontal lobotomy alters pain reaction without destroying perception. A patient having had such an operation is capable of saying, "I feel the pain but it doesn't bother me."

In spite of my belief that pain has no substantial reality, if I pull a muscle in my back the messages coming to my brain will be assembled and coded in such a way as to force on my consciousness a sense of unpleasantness and alarm which I will interpret as pain. I deem it painful because I deeply prefer that the muscle be healed instead of torn—because attention to these messages will enable me to favor and nurse the hurt area back to health—because I fear continuing in a condition of incapacity or deterioration—because unlike the Tarquin king, I have no guilt feelings about my back and no joy in destroying it.

But the idea of pain, however keen, is only an *idea*. I have created it with my mind and, if I knew how, I could banish it with the same mind. Until that technique is perfected, three cheers for the pain box and the aspirin tablet!

LETTERS

TO SCIENCE DIGEST

E.S.P.

My colleagues and I are very much gratified by this excellent article ("Science Gets Serious About E.S.P.," Nov. '65) with its front-cover introduction. I could not have asked for a more clear, interesting, balanced and informative treatment of the subject as it stands today—that is, within that amount of space, and the space was generous too.

J. B. RHINE
Foundation for Research on the Nature of Man
Durham, N.C.

Science Digest persists in publishing a lot of specious nonsense about psychic phenomena, chiefly the side-tracks in the standardized effort in this country to ignore the truth.

Your latest article was nothing but a shining example of what this business is not, and of the deliberate brain-washing that is being prompted in this country regarding it.

The facts, both in physics and psychics are known, provable and demonstrable to anyone who has reasonable intelligence and normal capacity for observation and detection. They are also reproducable by anyone who is willing to take the time, trouble and make the effort to follow through patiently and with perseverance on extremely simple instructions. The only difficulties lie in the purpose and understanding of the person making the attempt.

JERRY L. KEANE
Norwalk, Conn.

I wish to point out that precognition need not preclude chance and free will. Sensitivity to the evolvement of present "patterns" can enable one to alter that evolvement. If you foresee you will be killed on a bridge at 2 p.m. by a large, black car swerving in front of you, you may stay safely off the bridge, and at 2 p.m. watch the large black car swerve to where you would have been, had you not enjoyed precognition of the event.

DAVID S. WENTWORTH
Los Angeles, Calif.

I read the November issue of *Science Digest* with a great deal of interest and was especially engrossed in the E.S.P. article by Daniel Cohen.

I don't read *Science Digest* regularly and I can't tell why, because I always find it enormously interesting.

MRS. NATALIE HENDERSON
Winnetka, Ill.

I do not dig thee, Doctor Rhine.
The reason why, I can't divine.
But this I'll tell you, Doctor Rhine,
I am not on your party line.

LOUIS FARGO
Santa Monica, Calif.

Your article on E.S.P. has been very informative and deserves a "well done" comment in every respect.

A. E. EVANGELISTA, JR.
Chicago, Ill.

In your article on E.S.P., you did not mention "retrocognition", which is the ability to see events or recall events that have already transpired. I have read articles where a man with this "psi" function was able to go back to the scene of a crime and help the police solve it by giving such information as a description of the suspect gained through "psi" impressions received.

HERMAN ABRAMS
Miami, Fla.

"Retrocognition" is usually considered part of "clairvoyance."—Ed.

Pleasure and satisfaction

I am writing at this time to express my pleasure and satisfaction with the feature "Inside Psychiatry Today" which has been a "regular" in the magazine for many months.

This series is well formulated, carefully edited and appropriately documented. The feature provides highly useful information to lay readers concerning rapid developments in this medical specialty and is helping to remove the remnants of "mystery" that have for many years shrouded the profession.

As a mental health professional and as a long-term subscriber to *Science Digest,* I extend sincere congratulations.

WILLIAM S. HALL, M.D.
State Commissioner of Mental Health and Superintendent,
S.C. State Hospitals,
Columbia, S.C.

Reads every page

Science Digest was brought to my attention about five months ago by my mental health professor at Glassboro State College, in New Jersey. I was doing research for a paper on dreams, and she showed me an article on the subject that had appeared in an issue some years ago.

Since then I have become an ardent fan of your magazine, reading each and every page every month. I am a music teacher and my interest is on a layman's level. That is why I enjoy being informed in a language that I can understand. I wish *Science Digest* was twice the size so that there would be twice as much to read.

HARVEY SOIFERMAN
Cinnaminson, N.J.

Boy, girl (cont.)

In the November letters column discussion of an August quiz question Paul O. Winters is quite correct in his reasoning, but this reasoning is not necessary to prove author Fay wrong.

The order of birth is, of course, a total irrelevancy. The point is that the birth of the unmentioned child, whether it took place before or after the birth of the mentioned child, was independent of all previous or subsequent births, just as the toss of a coin is independent of all previous or subsequent tosses. And just as the chances of a coin coming up heads or tails are always 50-50, so the chances of any birth producing a boy or girl are always 50-50 (assuming that for purposes of the quiz we ignore the statistical fact that more girls are born than boys).

Author Fay's complicated manipulation of probability equations and situations is pure pseudo-intellectual doubletalk, and the editors ought to have known it in the first place. Shame on all of you.

ALFRED D. BERGER
New York, N.Y.

A prototype glass sphere for deep sea research is "modeled" by two men. An experimental model of the 4.5-foot sphere is now being built for the Navy by Corning Glass.

Man-sized bubble

GOING to the bottom of the sea in a bubble has a certain poetic beauty to it. Soon it may have practical significance, too.

At the Naval Ordnance Test Station, China Lake, Calif., technicians are studying the possibility of using glass spheres for undersea exploration.

Says Dr. William B. McLean, technical director of the China Lake station, "It's not easy to get acceptance for the use of glass, because people think of it as being fragile. Yet glass in compression, as it would be at great depths, is stronger than any other material."

So far, only small glass balls have been tested, but a 4.5-foot sphere is currently being built by Corning Glass for further tests. The sphere will have walls 1.5 inches thick, weigh about 1,100 pounds and accomodate two men.

Research indicates that glass spheres can be used to depths of 20,000 feet and the range might be extended to 36,000 feet for ocean trenches.

Aside from its strength under pressure, the advantage of glass is cheaper construction costs.